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The Use of Instrumental Enrichment With Hearing Impaired Adolescents

by

© JUDITH ANN PACHAL

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF EDUCATION

IN

Special Education

Department of Educational Psychology

EDMONTON, ALBERTA

Fall 1986

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled The Use of Instrumental Enrichment With Hearing Impaired Adolescents submitted by JUDITH ANN PACHAL in partial fulfilment of the requirements for the degree of MASTER OF EDUCATION in Special Education.

Supervisor

Date September 12, 1986

Abstract

Teachers of hearing impaired adolescents frequently express concern over some of their students' serious deficiencies in problem solving skills (Martin, 1984). This study investigated, in a qualitative manner, the use of Feuerstein's Instrumental Enrichment program in remediating such deficiencies in four oral hearing impaired adolescents. Special emphasis was given to self regulatory behaviors and verbal problem solving strategies in describing changes in cognitive functioning.

Results of this investigation suggested five potential areas of benefit in cognitive functioning as a result of students' participation in one year of Instrumental Enrichment programming. Clearly however the benefits were highly individualized with certain students being more greatly affected than others, and with support from standardized measures being limited.

First, in three of the four I.E. students, impulsive behavior was apparently being replaced by restraint of impulsivity and more reflective thought. Development of this deficient function was observed in delayed decision making through exploration of multiple alternatives and hypothesis testing.

In three of the students, planning behavior was apparently replacing unsystematic work. The use of more systematic approaches to daily work was observed as well as more relevant and complete oral responses. Reflection of

these behaviors in test results was observed in the CELF and Reading Closure tasks.

Second, to varying degrees, each of the four I.E. students assumed a more active role in the learning process as observed in their increased participation as speakers and listeners in class discussion, and in their increased willingness to read instructions spontaneously. Some of the students also became more willing to consult reference materials rather than relying on the teacher to act as "information giver". Unexpectedly, reflection of these behaviors in test results was not seen in the results of the SPAS.

Third, three of the students were observed to generalize and to apply vocabulary and concepts used in I.E. class to other classes. Vocabulary items such as "referent", "impulsive", "strategy", and "plan" were among those most frequently observed. More significantly, students began to spontaneously apply principles and strategies learned in I.E. class to real life. No reflection of these behaviors was seen in the CTBS-Math Problem solving scores.

Fourth, each of the four students became increasingly more precise in their work and in their use of language, as well as more demanding of precision in others. Evidence of increased precision was observed in increased attention to detail and neatness, and use of spatial referents other than "here" and "there". Reduced egocentrism in communication, through more adequate referencing of indefinite and personal

pronouns, was also observed.

Fifth, three of the students demonstrated increased ability to think logically, to make inferences, and to draw conclusions. The emergence of spontaneous support for answers and opinions was observed in addition to several examples of spontaneous hypothetical thinking. These behaviors were reflected in the test scores of EPS Elementary Reading Test as well as reading closure tasks.

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I. Introduction and Overview

A. Introduction

The concept of educating all children, including the exceptional child, to the limits of their capacity is relatively new (Kirk, 1972). According to Kirk (1972) and Harth (1982) an important change over the past three decades has begun to replace the old philosophies toward educating exceptional children. The change has occurred through a gradual infiltration of increasing optimism for teaching exceptional children to adapt to their mainstream environments. Awareness of the new era has become more clearly focused, in part, through the work of psychologist, Reuven Feuerstein. (Hobbs, 1980; Harth, 1982). Feuerstein categorizes attitudes toward exceptionality along a continuum; the extremes of the continuum he labels as the Passive Acceptant Approach and the Active Modificational Approach. (Feuerstein & Reimer-Jensen 1980a).

Since the nineteenth century, educational programs for handicapped children have been drawn toward an approach which Feuerstein labels as the "Passive Acceptant Approach". (Sabatino, Miller, & Schmidt, 1981; Narrol & Giblon, 1984). Within this approach, each individual's low level of functioning is seen as clear evidence of their limited potential which is accepted as basically unchangeable. Therefore, programming and educational environments are modified to accommodate each child and to make them as

comfortable as possible (Feuerstein et al., 1980a). "Educational programs based on this approach were primarily designed to prepare an individual to function at this low level ... in a marginal, perhaps semi-dependent, environment". (Harth, 1982, p.1).

A more optimistic philosophy toward development has evolved and is discussed by Feuerstein as the "Active Modificational Approach". This approach does not perceive the student's current level of functioning to be an accurate reflection of a fixed potential, nor does it propose that the environment should be modified to each child and thereby confine them (Feuerstein et al., 1980a). The student's mind is viewed not as "carved in cerebral marble but rather [of] a soft plastic that could be shaped almost at will" (Chance, 1981, p. 63). The individual is perceived as an open system which is highly responsive to change under the appropriate conditions (Hobbs, 1980; Helgason, 1983; Feuerstein, Hoffman, Jensen, & Rand, 1985). Educational programs based on the Active Modificational Approach provide a source of pressure to stimulate development and are intended to "move the individual to increasingly higher levels of functioning" (Harth, 1982, p.1).

Feuerstein's Application of the Active Modificational Approach

Between 1950 and 1954, Feuerstein came in contact with, and later became responsible for educating, a number of

Jewish children brought to Israel. The children had barely survived the Second World War (Feuerstein, Krasilowsky, & Rand, 1974; Hobbs, 1980; Helgason, 1983). Their childhoods had been spent in hiding and fighting for survival during the critical periods of the early and middle years of their lives. War had not offered these children an equal opportunity to play, to learn, and to proceed along the normal course of cognitive development. As a result of his contact, as well as his commitment to the Active Modificational Approach, Feuerstein later developed two tools for the purpose of pinpointing and overcoming the cognitive delays he observed in his students:

1. The Learning Potential Assessment Device, (LPAD)
2. The Instrumental Enrichment Intervention Program (I.E.)

It is Feuerstein's Instrumental Enrichment Intervention Program for cognitive modifiability which is of interest to this researcher.

Dr. Feuerstein has worked with numerous students of varying etiologies. What his students have in common is their retarded levels of cognitive performance. Regardless of etiology, and for reasons related to his theory of normal cognitive development, Feuerstein prefers to recognize the individuals simply as "culturally deprived".

To date, Feuerstein himself has not applied his intervention program for cognitive modifiability to hearing impaired adolescents; yet some members of this population

can be portrayed as deprived of their culture, or deprived of sufficient mediated learning experiences due to communication barriers between these children and their families. The purpose of this research was to study the use of Instrumental Enrichment programming with hearing impaired adolescents. Of particular interest were changes in a number of self regulatory behaviors considered by Feuerstein as prerequisite to effective learning.

B. Development of Underlying Concepts

A brief overview of the major concepts underlying Feuerstein's work is required to lay the foundation for illustrating the relevance of his work to the needs of hearing impaired adolescents and to the significance of this research. Therefore, the remainder of the introduction to this research provides the reader with a very fundamental understanding of Feuerstein's theory. The major concepts to be addressed will include Feuerstein's use of the following concepts and their application to hearing impairment:

1. Cultural Deprivation
2. Etiology of Cognitive Deficiencies
3. Mediated Learning Experience

Cultural Deprivation

Feuerstein carefully differentiates between the concepts of "cultural deprivation" and "cultural difference" (Feuerstein, Rand, Hoffman, & Miller, 1980b; Helgason, 1983;

Narrol & Giblon, 1984). He clearly states that cultural deprivation does not refer to the culture itself as being deprived or lacking, and therefore producing deprivation in its members. Instead, the concept refers to a failure on the part of the members of a particular culture to successfully transmit to the new generation the knowledge, values, and beliefs comprising their culture. (Feuerstein et al., 1980a, 1980b; Narrol & Giblon, 1984).

Without benefit of this perspective of generations of cultural patterns, values, and attitudes, the culturally deprived individual perceives the world episodically and devoid of depth and detail (Feuerstein et al., 1980a; Feuerstein et al., 1985). As a result "the syndrome of cultural deprivation produced by a lack of mediated learning experience is manifested mainly by a lack of or reduced" capacity to become modified by direct experience (Feuerstein et al., 1980a, p. 410).

"Cultural difference", by comparison, is the opposite of culture deprivation. Cultural difference depends on the successful transmission of a culture to the new generation so that a strong cultural identity and sense of membership is produced.

Culturally deprived individuals are lacking in this cultural identity and framework for organizing their experiences. Because they were deprived of cultural transmissions gained through mediated learning experiences, they were, in effect, also deprived of the opportunity to

learn the more efficient cognitive functions which permit them to learn through their experiences in the world.

Etiology of Cognitive Deficiencies

Feuerstein employs two constructs in his explanation of the origin of cultural deprivation - the distal and the proximal determinants of differential cognitive development (Feuerstein et al., 1980a, 1980b). It is the relationship between these two constructs which he believes leads to "varying courses of cognitive development in otherwise similarly endowed individuals under similar conditions of stimulation" (Feuerstein et al., 1980b, p.16).

The distal determinants include such variables as heredity, organic conditions, environmental stimuli, socioeconomic status and emotional balance. According to Feuerstein (Feuerstein et al., 1980a), although a deficiency in one or more of these factors can contribute to inadequate cognitive development, these factors do not directly, or unavoidably, determine the outcome of cognitive development; the distal factors may lead to an individual being at greater risk of becoming a retarded performer. "Thus the distal etiological factors are defined as determinants that neither directly, nor inevitably lead to inadequate cognitive development" (Feuerstein et al., 1980, p.17).

The proximal determinant of differential cognitive development, according to Feuerstein, includes only one variable - exposure to mediated learning experiences. A

deficiency in this factor, by way of a lack of, or reduced exposure to, mediation unavoidably results in retarded performance (Feuerstein et al., 1980b). According to Feuerstein, inability to find ways to break through barriers, such as hearing loss, posed by the distal etiological factors may mean that this cultural information is not successfully transmitted. "Conversely, if appropriate strategies ... are provided, such that the barriers obstructing mediation are overcome or bypassed, then it becomes possible to avert the expected course of retarded development and to restore a normal pattern of cognitive growth" (Feuerstein et al., 1980b, p.17).

The following case description is in actuality a composite description drawn from the literature. It is intended to serve as an illustration of the applicability of Feuerstein's concept of cultural deprivation to the field of hearing impairment. Cultural deprivation in the hearing impaired child is portrayed here as the lack of a well developed framework of cognitive functions through which to organize, understand and be shaped by one's experiences in the world. Because language is both a part of culture as well as an important vehicle for its transmission, it can be anticipated that hearing impaired children educated in the English-Canadian culture may have difficulty benefitting from the mediated learning experiences which would normally teach them the efficient cognitive functions they require; as a result, these functions may not fully develop. (This

study does not address the characteristics of those children for whom the deaf culture and the language of American Sign is dominant).

Case Description

Born severely hearing impaired, as a result of maternal rubella, (Mindel & Vernon, 1971), John's family chose to educate him through oral/aural programming (Meadow, 1980). He obtained the binaural amplification he required at the age of four and utilized his hearing aids consistently both at home and at school after they were acquired.

As a young child, John's family was unable to communicate with him in such a way that he could understand their explanations of his experiences. Without being keenly aware of it, John's mother had come to feel guilty as well as rejected by the child through his failure to respond to her attempts to elicit responses from him (Harris, 1978a). The language she used and the manner in which she interacted with him became rigid. John's mother expressed frustration with her inability to reliably understand or be understood by her own child (Schlesinger & Meadow, 1972). The family's behavior control strategies were restricted to physical punishment or restraint (Harris, 1978a). Discussion and explanation were not employed (Bernstein, 1960; Hess & Shipman, 1965, 1967). Verbal interaction became likewise restricted to unelaborated commands. "As a result, the child was doubly deprived, the first deprivation arising from his deafness, and the second from the effect of his disability on the environment" (Harris, 1978a, p.62).

By the end of his twelfth year in special programming for hearing impaired students, he had learned to read and write at approximately a grade five level (Gentile & DiFrancesca, 1969; Trybus & Karchmer, 1977; Quigley & Kretschmer, 1982). Both his language and reading comprehension reflected limited success in inferential and critical thought (Sarachan-Deily, 1985). His work was frequently completed impulsively without attending to the similarities and differences between experiences which would make his learning task easier (Rohr-Redding, 1985). He did not search out ways of organizing and relating his experiences perhaps because he lacked the tools and the strategies with which to do it (Athey, 1980).

John's incomplete understanding of his experiences in the world is analogous to the incompleteness of a map's representation of the real world. The map represents the world as what appears to be isolated land masses floating on bodies of water. The underlying structure of mountains and valleys below the depths of the water, which serve to unite and interconnect the land masses, do not exist in this representation. Similarly, John's cognitive "map of the world" is equally incomplete. John demonstrates easy access and good understanding of selected concepts and knowledge. He does not, however, have access to, or even perceive the existence of, underlying interconnections between his islands of knowledge. He does not easily generalize his understanding of one part of the world to other parts. Each is separate and each has its own rules and boundaries.

John has been deprived, to a certain extent, of sufficient mediated learning experiences through which to learn his culture. More precisely, because of a lack of success in breaking through the existing communication barrier, he was unable to learn certain essential prerequisite skills enabling him to effectively organize and learn from his experiences.

Though John's difficulties are typical of hearing impaired children, the group is not entirely homogeneous. Until now the field of educational psychology has been at a loss to explain such occurences of cultural deprivation whereby some hearing impaired children are deprived of their

own culture, while others are not. Feuerstein's perspective with respect to the distal, or distant, relationship between hearing impairment and cognitive development appears to provide a very useful tool for explaining this phenomenon. A more detailed development of the direct, or proximal cause of cognitive deficiency, known as mediated learning experiences, is provided in the following section.

Mediated Learning Experiences

Understanding of the process of cognitive development has historically been both limited and surrounded by controversy. Traditionally, Piagetian psychologists have used the Stimulus - Organism - Response (S-O-R) model to explain the development of cognitive structures by direct exposure to stimuli (Feuerstein et al., 1980a, 1980b; Tough, 1974). According to Harth (1982), this type of interaction is characteristic of most living organisms, including man. The environmental stimuli affect the organism cognitively and behaviorally which in reaction affects the way in which the organism interacts in the environment (Harth, 1982). Although Feuerstein is a former student of Piaget, the S-O-R model emphasizing direct experience cannot, to Feuerstein's satisfaction, be considered the salient ingredient that accounts for differential cognitive development in otherwise similarly endowed individuals.

Owing to the inadequacy of the S-O-R Model, Feuerstein postulated the coexistence of a second type of interaction

which is less universal and characteristic only of mankind. Into the S-O-R Model, Feuerstein interjects a human mediating agent between the environmental stimuli and the organism (S-M-O-R) (Feuerstein et al., 1980a, 1980b). This mediator acts as an "interpreter" through which environmental stimuli are transformed, reordered and organized for the organism "in the direction of some specifically intended goal or purpose" (Feuerstein et al., 1980a, p.409).

> A mediating agent, usually a parent, sibling or other caregiver guided by his intention, culture and emotional investment selects and organizes the world of stimuli for the child. The mediator selects the stimuli most appropriate and then filters and schedules them... (Harth, 1981, p.226).

Mediated learning experiences are characterized by the presence of at least five distinct components of which the first three are absolutely essential if the interaction is to have mediational value (Feuerstein et al., 1980a, 1980b, 1985). The components are:

1. **Intentionality** - Mediated learning experience is an interaction marked by the intentionality of the caregiver, and often the child as well, to develop a specific response in the child.
2. **Transcendence** - The experience transcends the immediate problem or situation by enriching the

experience with explanation and information not specific to the present situation. Expected to generalize this information, the child will better understand similar experiences in the future.

3. **Meaning** - The experience makes clear to the child the meaning of the learning which goes beyond that which can be grasped by the senses alone.
4. **Competency** - The experience fosters in each child a growing sense of competency in their ability to organize and understand experiences. It may also convey that in the future the child will assume the mediating function for upcoming generations.
5. **Regulation of Behavior** - The experience provides a vehicle through which behavior is regulated (initially by the adult) and insight is fostered as to how and why behavior must be monitored. As this insight develops the child assumes greater responsibility for this function.

As a result of the mediating process, each child acquires the behavior patterns expected of them within the context of their culture, but more importantly, they also acquire skills and behaviors prerequisite to thinking which maximize their benefit from direct experience. Without adequate mediated learning experiences the hearing impaired child, like Feuerstein's other culturally deprived children, may fail to develop efficient cognitive strategies for organizing experiences and instead may be very likely to

develop interfering habits and behaviors which Feuerstein calls deficient functions (Shown in Appendix A).

In summary, Feuerstein's theory, when applied to hearing impairment, would emphasize that hearing loss is the distal factor which may or may not trigger a deficiency in the proximal determinant - mediated learning experiences. It is this lack of mediated learning which inevitably and unavoidably results in cultural deprivation and deficiencies in cognitive functions for many hearing impaired children.

The optimism in Feuerstein's theory of cognitive development lies in his belief that to prevent or remediate deficiency, one must simply provide the student with adequate mediated learning experiences. It is this thesis which lead Feuerstein to develop a highly structured and systematic program of intervention designed to provide carefully sequenced mediated learning experiences.

C. Feuerstein's Instrumental Enrichment Program

Based on his theory of cognitive modifiability and mediated learning experiences, Feuerstein has developed an intervention program known as Instrumental Enrichment for use with culturally deprived adolescents. Through program, the students learn to become their own mediators and to organize and adapt to their environment.

The major goal of the program is to increase the capacity of students to be modified by direct experience in their environment (Feuerstein et al., 1980b, 1985) but

Feuerstein identifies six more specific subgoals of the program which serve as stepping stones to the major goal:

1. The correction of deficient cognitive functions at the input, elaboration, and output phases
2. The development of systematic and precise work habits with incorporation of the basic cognitive skills as automatic functions
3. The development of intrinsic motivation and enjoyment of the process of learning
4. The development of necessary vocabulary, concepts, and operations
5. The development of a self concept as one capable of actively generating information rather than passively collecting or reproducing it
6. The development of an awareness of one's own mental processes in solving problems so as to repeat successes and eliminate failures

The entire two to three year program consists of over 500 pages of pencil and paper activities bound within 15 instruments. Depending upon the population, the program may require more than 300 hours of instructional time to complete. Feuerstein has chosen a separate rather than infused approach to cognitive education. He makes a conscious effort to avoid intermixing cognitive skill development with other curricular content for three distinct reasons (Feuerstein et al., 1985).

Firstly, the separation emphasizes that the program is oriented toward thinking processes rather than to thinking products. This focus is unlike much school curriculum which is frequently product oriented (Feuerstein et al., 1980b). This point is further emphasized by Feuerstein's decision to call the materials "instruments" rather than "workbooks". He conceives of the pages not as products to be learned but as instruments or vehicles to a much larger end - the development of efficient thinking habits (Feuerstein et al., 1980b). Appendix B outlines the contents of the four instruments normally taught in the first year of programming.

Secondly, developmental sequencing of information product objectives does not necessarily parallel that of cognitive skill objectives. Therefore, if cognitive skill objectives are to be presented in a developmental sequence, they must not be resequenced to comply with the pre-established sequencing of other school curricula.

Thirdly, the program avoids anticipation of failure by confronting students with novel, unschool-like and nonthreatening materials. The students do not therefore bring their fear of failure to this cognitive education program.

The aspect which distinguishes this program from other cognitive skill programs is that students are carefully guided to see that the strategies which they have learned to use in attacking the pencil and paper tasks are readily

generalizable to problem solving in all areas of life. Feuerstein calls the concept "bridging". The student creates a bridge across which to generalize from the I.E. lesson into real life. It may be for this reason that research, as well as individual teacher reports, document positive effects concurrent with student participation in the program in such areas as: problem solving, reading comprehension, and vocabulary (Narrol, Silverman, & Waksman 1982; Jonas & Martin, 1985).

In this chapter an overview of Feuerstein's program and underlying theory was provided. The focal point of the theory is that children may become retarded performers not because of a physical or emotional impairment but because they have not had the benefit of adequate mediation through which to develop efficient thinking habits. The optimism behind his theory comes from Feuerstein's belief that carefully structured mediation, such as that facilitated by his program, is not too late for adolescents. In the following chapter support is gained from the literature on deafness for exploring the use of Instrumental Enrichment with hearing impaired adolescents.

D. The Problem and Its Significance for Study

This study explored, in a descriptive manner, the use of Instrumental Enrichment with oral hearing impaired adolescents and was designed to answer the following question:

What behavioral changes were exhibited by hearing impaired adolescents involved in the regular Edmonton Public Schools Academic-Occupational high school curriculum in which one option was a daily 40 minute lesson in Instrumental Enrichment?

Data were also collected on a group of students who did not participate in Instrumental Enrichment programming. In both groups special attention was paid to changes in the following self regulatory behaviors:

1. Planning and restraint of impulsivity
2. Student responsibility in the learning process
3. Generalization of behaviors and concepts to new situations
4. Precision
5. Logical thinking

In addition, a number of standardized tests were administered to detect concurrent changes in performance in the following areas which may be linked to behavioral changes:

1. Verbal problem solving
2. Nonverbal reasoning
3. Academic achievement
4. Academic self concept
5. Use of language

This study has pursued a theory which attempts to explain the origin of disparity between the potential and the performance of the hearing impaired adolescent in a new way - through Feuerstein's concept of mediation. Because the literature suggests potential for useful application of Feuerstein's theory, it is also significant that this study should examine the use of Feuerstein's program of remediation as a possible means of minimizing this observed disproportionate relationship between hearing impaired adolescents' potential and their performance. The foundation laid by this study may facilitate the drawing of preliminary conclusions regarding the usefulness of Feuerstein's theory as well as contribute to identifying new questions to be answered by local researchers and educators of the hearing impaired regarding the relationship, and the development, of thought and language in hearing impaired children.

E. Overview

Teachers of hearing impaired adolescents frequently express frustration and lack of strategies for remediating serious deficiencies in problem solving skills displayed by some of their students (Cole, 1980; Martin, 1984). This researcher explored, through the techniques of descriptive study, the application of Reuven Feuerstein's thinking skills program in remediating such deficiencies in oral hearing impaired adolescents.

Chapter one provided an introduction to Feuerstein's Active Modificational philosophy of special education and a basic overview of three major concepts underlying his program of study. Included were his use of the term "cultural deprivation", as well as his perception of the etiology of deficient cognitive functioning, and the role of mediated learning experiences. The goals and design of his program were also overviewed.

Chapter two surveys the literature on deafness and Instrumental Enrichment. The purpose of this chapter is two fold. It demonstrates the rationale for applying this program to hearing impaired adolescents as well as supports the rationale behind the descriptive design of this study.

Founded on the rationale developed in chapter two, chapter three provides a description of the design and methodology underlying this research. The chapter also includes a detailed description of this researcher's use of anecdotal observation as well as the testing instruments selected and administered for the purpose of data collection.

Chapter four details and discusses the major results of this research. Special emphasis is given to changes in self regulatory behaviors observed through the use of anecdotal observation and open ended strategy interviews. The testing data is used to detect changes in achievement and performance which may be linked to the behavioral changes.

Chapter five draws conclusions regarding the effectiveness of the Instrumental Enrichment Program with hearing impaired adolescents. A number of suggestions for further research are provided which primarily focus on enhancing understanding of the interrelating processes of language and cognitive development in hearing impaired children.

II. Survey of Related Literature and Research

A. Introduction and Chapter Overview

The rationale for investigating the use of Instrumental Enrichment with hearing impaired adolescents rests largely on the foundation that it is an appropriate application of Feuerstein's work. Generalization to the hearing impaired student stems from Feuerstein's theory that retarded performance can be traced to inadequate mediated learning experiences rather than limited cognitive potential due to distal factors such as hearing loss. The purpose of this chapter is to demonstrate, through examination of the literature, that the potential exists for useful and appropriate application of this theory to the field of hearing impairment.

First, literature is reviewed which indicates that the cognitive potential of hearing impaired subjects, when measured nonverbally, is not limited by their hearing losses. Evidence of deficient functions is reported in the literature on specific cognitive tasks, social development, and reading achievement and it is explored as a means of explaining the hearing impaired child's retarded academic performance. The appropriateness of perceiving a hearing impaired child as a retarded performer of normal intellectual potential is thus supported.

Second, the disparity between the performance of hearing impaired children and their potential is addressed

through literature which emphasizes the importance of the role played by language in cognitive development. The relationship of thought and language is discussed in light of the work of Furth and Vygotsky.

Third, the literature on parent-child interaction is re-examined in light of Feuerstein's mediated learning construct. The nature of the language abilities and learning experiences of young hearing impaired children is compared to those of children with normal hearing. Emphasis is given to the widely documented lack of effective two-way communication between hearing parents and their hearing impaired children to highlight the increased potential for inadequate mediated learning experiences.

Fourth, after demonstrating the potential appropriateness of Feuerstein's theory to hearing impairment a review of the research into the use of Instrumental Enrichment with a variety of populations is provided.

B. Deafness

The Hearing Impaired Child as a Retarded Performer

Intelligence: Evidence of Potential

The first source of literature supporting the hearing impaired child as a retarded performer comes from the study of intelligence and deafness. The more recent literature in this area complements Feuerstein's

theory of differential cognitive development by providing evidence which parallels Feuerstein's belief that hearing loss does not limit cognitive potential. This conclusion, however, has been only recently drawn by those studying intelligence and deafness due to problems associated with designing cognitive tasks which do not confuse linguistic and cognitive variables (Meadow, 1980). As a result of inattention to these factors, conclusions of researchers have greatly differed throughout history. The conclusions regarding intelligence and deafness can be classified into three distinct historic phases (Quigley & Kretschmer, 1982).

Researchers of phase I concluded that the deaf were intellectually inferior (Pinter & Reamer, 1920; Pinter, Eisenson, & Stanton, 1941). In phase II researchers concluded that the deaf were of equal intelligence to the hearing, but were more concrete thinkers (Myklebust, 1960). Researchers of phase III, the most current phase, conclude that the hearing impaired population possesses the same distribution of intelligence as the hearing population, providing the tasks themselves are not language based and the instructions are given nonverbally (Rosenstein, 1961; Furth, 1966b; Vernon, 1967). A slightly lower mean may be observed due to etiologies having multiple effects (Vernon, 1969).

Differences between hearing and hearing impaired subjects in the performance of certain cognitive tasks

have been observed on several tasks including classification and concept formation, sequential memory, conservation of liquids, and transitive thought (Quigley & Kretschmer, 1982). These differences are now explained by factors such as experiential deficit, linguistic deficit or communication handicap (Furth, 1966b) rather than due to intellectual inferiority or concreteness of thought, as earlier believed. The controversy of this stage revolves primarily around whether or not it is possible to consistently identify a pattern of nonverbal cognitive tasks on which hearing impaired subjects perform less well than hearing subjects. Currently, researchers do not agree as to whether such a pattern exists, nor is there agreement as to why deficiencies exist at all (Quigley & Kretschmer, 1982). Further research, which avoids the confusion of linguistic and cognitive variables through more thoughtful selection of tasks and administration procedures, is required to advance our understanding of deafness and intelligence. However, even at present the research is indicating that the intellectual potential of hearing impaired subjects is not limited by their hearing losses.

Educational Achievement: Unrealized Potential

The second source of literature portraying the hearing impaired child as a retarded performer comes from the study of educational achievement. Despite findings which indicate a normal distribution of intelligence among the deaf population, mean levels of achievement are disproportionately low, (Wrightstone, Aronow, & Moskowitz, 1963; Furth, 1966a; Fiedler, 1969; Gentile & DiFrancesca, 1969) and have not basically changed over the past 20 years (DiFrancesca & Carey, 1972; Trybus, Buchanan, & DiFrancesca, 1973; Trybus & Karchmer, 1977; Jensema & Trybus, 1978; Quigley & Kretschmer, 1982; Serwatka, Hesson & Graham, 1984).

After reviewing a number of studies including those mentioned above, Quigley and Kretschmer (1982) concluded that in general, deaf students leave school at age 19 having a general educational achievement of sixth grade or lower, reading levels of grade four or five and spelling and arithmetic levels at the seventh grade level.

The performance of deaf children appears to be retarded in most areas of academic achievement though it is their performance in reading and language which is particularly relevant to this study. Based on closer inspection of the achievement scores in reading, four generalizations can be made.

First, the overwhelming majority of hearing impaired adolescents and young adults are seriously delayed in their reading skills (Trybus & Karchmer, 1977). Only 12% of hearing impaired students ages 15-16 received scores corresponding to a grade 4.9 level of functional literacy (Wrightstone, Aronow, & Moskowitz, 1963). The rest of the students scored below this level of literacy. Even as young adults, only 50% of students age 20 read at a grade 4-5 equivalent making them literate enough to read the newspaper (Trybus & Karchmer 1977).

Second, the reading scores of hearing impaired students do not show the constant or steady increase across grades one might expect. As hearing impaired children get older, they generally fall further and further behind their hearing age mates. Trybus and Karchmer (1977) found that the differences in reading achievement between hearing impaired children and their hearing peers increased from 1.5 grade levels at age 9 to more than 5 grade levels at age 14. Quigley and Kretschmer (1982) observed that a recurring plateau has been discovered in the reading scores of 13 and 14 year old deaf students as they reach the equivalent of a grade three or four level. From that point on very little change is observed by the age of 19.

Third, in the past two decades it is obvious that no real change in functional literacy of hearing

impaired students has occurred (Quigley & Kretschmer, 1982) and that the mean level of reading achievement of hearing impaired students is very discrepant to what one would expect given scores of intellectual potential.

Fourth, the retarded levels of reading achievement among hearing impaired students, which have been well documented by North American researchers, seem to be universal. Conrad (1977) reports similar retardation in the literacy levels of students in England, Wales, Sweden, Denmark, and New Zealand.

Given that there is no evidence to suggest less than the normal range of intellectual potential, the hearing impaired student seems indeed to be a retarded performer; little insight has been gained from studies of achievement which may explain the hearing impaired student's limited success. One possible explanation is explored in the following section which examines the strategies, skills, and processes which may underlie the hearing impaired child's retarded performance.

Evidence of Deficient Cognitive Functions

The third source of literature portraying the hearing impaired child as a retarded performer provides evidence of deficient cognitive functions which may underlie performance. Though researchers in deafness have not investigated cognitive functions per se, when their results are re-examined in light of Feuerstein's work, as summarized in Appendix A, evidence of deficient functions may be gleaned from their documentation.

In his review of the literature Martin (1985b) observed that hearing impaired students were experiencing difficulty on a number of specific cognitive skills which when superimposed onto Appendix A suggests both Feuerstein and researchers in deafness may be discussing similar phenomenon under different labels.

1. **Short Term Memory**: Karchmer and Belmont (1976) replicated studies documenting inferior performance but also observed that deaf subjects, with training in selecting appropriate memory systems performed as well as hearing subjects who selected their own strategies.
2. **Opposition** (Furth, 1964; Meadow, 1980).
3. **Analogy** (Meadow, 1980)
4. **Superordinate Reasoning** (Meadow, 1980)
5. **Cause-Effect Relationships** (Johnson, 1981)

6. **Working with more than one type of data** (Ottem, 1980).

A sampling of the literature in reading comprehension and social development of hearing impaired children suggests similar specific difficulties which also relate closely to functions identified by Feuerstein:

7. **Selection of relevant cues**: Strategies for test taking include selection of answer based on spatial cues (Webster, Wood, & Griffiths 1981) or irrelevant key words (Scouten, 1980; Webster, Wood, & Griffiths, 1981, LaSasso, 1985). As many as 85% of LaSasso's subjects used the word matching technique. One third of the students used the technique half of the time. One explanation of the origin of the test behaviors relates closely to teacher behaviors. Teachers of the hearing impaired may promote this type of behavior in their students by accepting key words rather than demanding precise responses (LaSasso, 1985) leading to passive unquestioning styles of learning (Furth, 1973; Webster, Wood, & Griffiths, 1981).
8. **Inferential-hypothetical thinking**: Sarachan-Deily (1985) found that the likelihood of deaf students to make a correct inference was as great as the likelihood of a false inference

and that this difficulty persisted into adulthood (Walter, 1975; Crandall, 1982). Sarachan-Deily refers to the work of Hansen and Hubbard (1984) in her argument that deaf students, like other poor readers, may not realize that it is their task to create meaning as they read. In addition, they may have less formal training and practise in inferential thinking in their reading and language classes.

9. **Impulse Control**: Several studies of impulse control in the hearing impaired population report emotional immaturity, short attention span, poor impulse control, egocentricity, and rigidity in higher incidence than among hearing children (Myklebust, 1960; Neyhus, 1964; Klaber & Falek, 1969; Schlesinger & Meadow, 1972; Thompson, 1974; Schein, 1975; Altschuler, Deming, Vollenweiden, Rainer, & Tendler, 1976). Some researchers have argued that it is the loss of auditory input which appears to have a retarding effect on impulse control and social maturity in hearing impaired adolescents (Altschuler et al., 1976). However, something which has gone unnoticed is that in many instances individuals and certain subgroups, including deaf children of deaf parents, demonstrate adequate self control thus

suggesting that audition is not the key (Harris, 1978; Moores, 1973). Research by Binder (1970) supports and refines the conclusion that it is neither loss of auditory input or lack of oral language skills which are responsible for differential social development.

In summary, the literature reviewed thus far portrays the hearing impaired child as a retarded performer. Performance is retarded in the sense that academic and social development is widely discrepant to what one would expect given essentially normal intellectual potential. A number of deficient cognitive functions which appear to be interfering with the hearing impaired child's performance can be inferred from findings of those studies surveyed. A convincing case is made by those who argue that it is through exploration of the relationship of thought and language that one may account for the wide discrepancy between the potential and the actual performance of hearing impaired children.

The Hearing Impaired Child as Inadequately Mediated

Feuerstein maintains it is through the process of mediated learning experiences that the child develops the efficient cognitive functions which are said to be the prerequisites to learning. Essentially, this mediation

process is a communication process initially occurring between the child and the caregiver, or teacher. Ultimately the child learns to mediate independently. The process of mediation clearly revolves around the relationship between thought and language.

The following sections will explore the hearing impaired child as a child who is not adequately mediated. The discussion is presented under three topics:

1. The Relationship of Thought, Language and Deafness
2. The Language Competence of Hearing Impaired Children
3. Opportunities for Mediated Learning Experiences

Relationship of Thought, Language and Deafness

The relationship of thought and language is a very complex one.

> Facility with language clearly sets an upper bound on an individual's communication skills; the extent to which such facility also limits a person's cognitive abilities more generally, is a matter of controversy. (Nickerson, 1978, p.115)

In general little is known about the relationship as it applies in normal development. Even less is known of the relationship with respect to hearing impairment. The work of two theorists, Furth and Vygotsky, has been instrumental in assisting to understand the relationships. Though generally the theories are presented in opposition, they can also be viewed as complementary descriptions of the same phenomenon. Furth sees language primarily for the purpose of communicating with others and investigates the existence of thought without language believing experience to be the origin of thought. Vygotsky, in contrast, perceives language to be the vehicle of thought, and therefore essential in communicating with oneself.

Furth

According to Furth, and other members of the Piagetian school, thought is primarily dependent on concrete experience rather than language. Development of thought originates from the information supplied to the child through sensorimotor activities. Language becomes important because it "may increase the powers of thought in range and rapidity" (Piaget & Inhelder, 1969, p.86). It allows one to make quick reference to a sequence of actions or a structure built from numerous actions. According to Tough (1974), language frees the child's thinking from the restrictions of present situation. However, what children can express through language is said to be dependent on the developmental level of their inner nonverbal frames of reference not the reverse.

The work of Furth and others has attempted to discover whether or not any basic malfunction exists in the deaf information processing system which would account for the observed difficulties in acquisition of knowledge. The central assumption to this type of research is that if no inner malfunctions can be discovered, then support for the supremacy of the relationship between thought and concrete experience would be gained. Any

difficulties in acquisition of knowledge would be due to deficiencies outside of the deaf person such as experiential, linguistic, or communication deficits (Levine, 1976).

Pursuing this paradigm researchers developed nonverbal cognitive tasks in addition to using the tasks of conservation developed by Piaget. In general, the results of such investigations have been mixed and have lead to few new insights into the relationship of thought and language (Quigley & Kretschmer, 1982).

Investigations into the preoperational and concrete operational stages of intelligence have neither lead to acceptance nor rejection of the theory that logical thought can occur independent of language (Quigley & Kretschmer, 1982). Consistent and conclusive results are yet to be obtained by researchers replicating Furth's work with hearing impaired subjects (Quigley & Kretschmer, 1982). Relatively little research has been done at the level of formal operations in part due to difficulties in devising nonverbal tasks which tap these skills yet can be conveyed to subjects using nonverbal means (Meadow, 1980).

Controversy exists as to whether or not a pattern of deficiencies in the performance of hearing impaired subjects on cognitive tasks can be

identified. According to some researchers, though hearing subjects consistently perform better than the deaf, no striking pattern of deficiencies can be identified (Schlesinger & Meadow, 1976; Furth 1971b).

Other researchers have, upon reviewing the findings of a number of studies, noted that consistently normal results have not been obtained on certain tasks (Liben, 1978; Quigley & Kretschmer 1982; Levine, 1976). Among those tasks on which performance of deaf children and hearing subjects has not been consistently equivalent are:

1. Classification and concept formulation (Templin, 1950; Oleron, 1953; Michael & Kates, 1965; Furth & Milgram, 1965)
2. Sequential memory (Blair, 1957; Olsson & Furth, 1966)
3. Conservation of liquids (Furth, 1964; Youniss & Furth, 1966a; Robertson & Youniss, 1969)
4. Transitive thought (Youniss & Furth, 1966a)

Furth (1971b) himself points out that those experiments in which deaf children are somewhat retarded in performance have produced far less conclusive interpretations than experiments where their performance equals that of nonimpaired subjects. Furth reasons that if deaf subjects

succeed, one can infer conclusively that the missing factor, language, is not a prerequisite for the task. If they do not succeed, one cannot conclude that the factor is directly related to the subjects' failure due to the influence of other uncontrolled factors.

Furth's line of reasoning has been questioned by Conrad (1977), Levine (1976), and Moores (1978). He has been most severely criticized for his assumption that deaf subjects are necessarily without language, and therefore suitable subjects in testing the theory of thought without language. Conrad believes that the major weakness of the paradigm under which Furth has worked, has been the assumption that internal language (linguistic competence) is either wholly present or wholly absent. With few exceptions according to Conrad (1979), no attempts have been made to determine linguistic competence in deaf subjects involved in such research. In the experiments it was taken for granted that subjects were without or massively deficient in language. Furth's work has also been criticized for failing to acknowledge the possibility of use of sign language by deaf subjects as the inner language of thought (Bornstein & Roy, 1973).

What is still missing, and crucially important from a Piagetian perspective, is a "clinical interview method" to probe for thinking and reasoning strategy. Hearing and deaf subjects may produce the same answer but follow very different paths to derive their answers (Levine, 1976). Cognitive research to date has failed to disclose the path used by deaf subjects.

It is clear that many of the preoperational and concrete operational experiments comparing deaf and hearing subjects must be repeated with greater attention to control several variables if any advancement of the understanding of the relationship of thought and language is to be made. Among those variables demanding greater control are: degree of hearing loss, oral language ability, sign language ability, and presentation of task. It would appear that Furth's most significant contribution to understanding the relationship of thought and language has not come from his research, which has been severly criticized. Instead, his contribution remains in the form of an untested hypothesis. He is persistent in his belief that concrete experience provides the critical foundation to cognition.

Vygotsky

Unlike Furth, Vygotsky (1962) and his colleagues believe that in cognition the role of language, rather than experience, is primary (Bruner, 1966; Kolberg, Yaeger, & Hjerholm, 1968). The concept of inner speech is central to Vygotsky's theory. He uses the term "inner speech" to capture what he believes to be the relationship of thought and language.

In reflecting on what is going on in one's own mind during the course of every day life it becomes apparent that much time is spent communicating with oneself in a speech-like medium (Conrad 1977; Costa, 1984). It is this use of language which Vygotsky explores.

Much of the research stemming from Vygotsky's theory has focused on the study of egocentric speech, or what is believed to be verbalized "inner speech". Unlike Piaget, Vygotsky does not believe that egocentric speech is an immature form of social speech or intended to serve the same function. Vygotsky believes the evolution and function of egocentric speech to be very different from that of social speech (Dale, 1976). Within the Vygotskian framework children are said to use egocentric speech not merely to accompany their actions, but to help them mediate and control those actions which they

are yet unable to control from within. Egocentric speech develops as a hybrid speech form having the structure and function of inner speech but is vocalized like social speech (Dale, 1976). Gradually, egocentric speech becomes more refined for its purpose of self guidance (Vygotsky, 1962; Kolberg, Yaeger, & Hjerholm, 1968) and it becomes inner speech as the vocalization disappears at approximately age six or seven (Dale, 1976).

Research applying the concept of "inner speech" to deafness revolves around two basic hypotheses - the first applying to the oral deaf and the second applying to signing deaf students. Application to oral students is founded on the hypothesis that deafness may not necessarily impair one's capacity for internal speech (Conrad, 1979; Hansen, 1985).

According to Conrad (1979), when deaf and hearing subjects were matched with respect to degree of internal speech, ability to remember familiar words was very similar. When the comparison was made based on matched reading ability there was a highly significant difference in ability to remember familiar words. Generally, when performance on memory tasks was influenced, recall was affected only for material which by its nature was better coded phonetically; other material was not affected.

The second application of Vygotsky's theory to the deaf involves those who use manual communication. Studies into sign language have lead researchers to conclude that sign language offers the deaf the same interpersonal and intrapersonal language functions as speech offers the hearing. Therefore it has been theorized that the practicality of an internal language other than speech must be considered (Bellugi, Klima, & Siple 1974; Odom, Blanton, & McIntyre, 1970).

A study by Odom, Blanton, and McIntyre (1970) demonstrated that deaf children have no trouble memorizing signs without ever learning the spoken word. Other researchers went a step further and demonstrated that the deaf are quite capable of remembering a memory task in sign without recoding into spoken words (Bellugi, Klima, & Siple, 1974). These findings provide evidence that sign language offers potential for serving as the equivalent of Vygotsky's "inner speech".

In summary, Vygotskian theorists believe language to be the primary symbol system of thought and therefore the vehicle of thought. The argument, as it applies to deafness, has taken two forms. First, Conrad and others argue that many hearing impaired children develop inner speech though they may not use it in the same situations as would a

hearing person. Second, it is argued by linguists that the language of thought would be more aptly named "inner language" rather than "inner speech", as it is the symbol system rather than the vocal aspect which is important (Belugi, Klima, & Siple 1974; Odom, Blanton, & McIntyre, 1970). This change in semantics would make possible the application of Vygotsky's theory to the manually communicating deaf population.

Bruner most elloquently summarizes what he believes to be the relationship of thought and language as follows:

> Language is a major instrument of thought (and) in some unknown but considerable measure, the power of words is the power of thought (Bruner, 1966, p.104, 105).

> In effect, language provides a means not only for representing experience but also for transforming it... Once a child has succeeded in internalizing language as a cognitive instrument, it becomes possible for him to represent and systematically transform the regularities of experience with far greater flexibility and power than before (Bruner, 1964, p.4).

Vygotskian theory has a particularly significant implication with respect to language and cognition among hearing impaired children. The implication is that without language competence, the symbol system of thought is impaired thus limiting cognition.

In the examination of the language competence of hearing impaired children which follows, it can be observed that hearing impaired children frequently experience language delays which can seriously impede their ability to communicate with others and may well impede effective communication with themselves.

Language Competence of Hearing Impaired Children

One of the most richly studied facets of hearing impairment appears to be the language of hearing impaired children. Yet it is difficult to make generalizations about the language competence of hearing impaired students except to say that most students display a delay in their language development (Kretschmer, 1976). A second school of researchers believe that in addition to the observed delay, there is some evidence of the coexistence of normal and deviant rule usage (Quigley, Wilbur, & Montanelli, 1974).

Kretschmer (1976) studied the written productions of 120 hearing impaired and normally hearing children using a transformational grammar approach to identify kernel sentences and transformations. The hearing impaired students produced less complex strings and their productions contained many more restricted forms than those of hearing children. Other than delayed development, no particular error patterns were identified among the hearing impaired students. Similar findings were also reported by Myklebust (1960), Moores (1970a), Sarachan-Deily (1982), and Schirmer (1985).

A second school of research has found evidence of the coexistence of deviant and normal rule systems in hearing impaired subjects. While it is agreed that normal rule systems governing many structures may

develop in hearing impaired children, evidence of the coexistence of normal and deviant rules has been observed in the following structures: passive voice, pronominalization, negatives, relativization, yes/no questions, wh- questions, tag questions and conjunctions (Quigley, Wilbur, & Montanelli, 1974; Quigley, Smith, & Wilbur, 1974; Quigley, Wilbur, Power, Montanelli, & Steinkamp, 1976; Sarachan-Deily, 1982).

There is some consensus in research findings (Kretschmer, 1976). First, a delay is observed in most deaf children's language performance. Second, a pervasiveness of deviant rule usage is confirmed particularly with respect to complex sentence patterns. Third, many of the language behaviors improve with age.

If hearing impaired children experience significant delays and deviances in their language, particularly with respect to complex patterns, then within a Vygotskian framework one must also suspect that the language impairment will affect intrapersonal communication, or self mediation, through "inner speech/language". Self mediation related to making inferences, drawing conclusions, and hypothetical thinking may be particularly vulnerable because of their association with the more complex linguistic structures.

The implications of language competence with respect to intrapersonal communication have already been explored. However, language competence and interpersonal

communication may also have far reaching effects particularly as they relate to parent-child interaction. The following section examines parent-child interaction as a function of the interpersonal communication barriers of language competence. Opportunities for mediated learning experiences are discussed in this context.

Opportunities for Mediated Learning Experiences

The importance Feuerstein (1980b) places on the adequacy of mediated learning experiences is echoed by other researchers stressing the importance of parent-child interaction in cognitive development (Bernstein, 1971, 1973; Tough, 1974). Though most children have similar concrete experiences upon which to draw meaning, even among children with normal hearing, important differences are observed in the way in which parents interact with their child and use language to help their child transcend their immediate experiences.

The work of Bernstein with normally hearing children is particularly relevant to Feuerstein's concept of mediated learning. Bernstein (1971,1973) and others found significant differences in the language used by parents of the lower class with respect to:

1. Their view of children
2. Purposes they report for talking with their children
3. Level of elaboration used in answering their children's questions (Strickland, 1962; Loban, 1963; Deutsch, 1965; Robinson & Rackshaw, 1967; Bernstein & Henderson, 1969; Brandis & Hendersen, 1970).

Hess and Shipman (1965, 1967) concluded that lower class children were not only offered very different

meanings for their experiences but actually a deprivation of meaning was occurring. Meaning intrinsic to the situation was not being transmitted to the children of lower class families. These children were followed up in the primary grades and it was found that maternal teaching styles related strongly to the child's school performance. Bernstein (1960) aptly summarizes the difficulty as follows:

> The central problem for the lower class child is primarily that of learning <u>how</u> to learn and secondly that of learning <u>what</u> has to be learned. (Bernstein, 1960, p.165).

It would appear that the learning difficulties Bernstein describes which may be experienced by children of lower class families are very similar to those described by Feuerstein within the context of inadequate mediated learning experiences. The five components of a mediated learning experience seem to be closely related to the parameters which distinguish the elaborated and restricted language codes. A review of literature studying the interaction between hearing impaired children and their parents reveals a very similar potential for inadequate mediated learning experiences.

Given that 90% of hearing impaired children are born to hearing parents (Schlesinger & Meadow, 1972) and that many parents go through various stages of guilt,

anger, grief, and depression (Mindel & Vernon, 1971) in coming to accept their child's hearing loss, then these coping mechanisms combined with altered communication patterns may well affect the parents' nurturing roles (Quigley & Kretschmer, 1982) and thereby disrupt the process of mediation (Keane, 1985).

Schlesinger and Meadow (1972) observed that mothers of deaf preschool age children:

1. Showed more disagreement, tension, and antagonism than mothers of hearing children
2. Used less praise
3. Showed very little use of questions
4. Reported communication as the most serious child rearing problem; 38% reported their child could not understand them and 15% could not understand their own child's communication attempts

In addition, Meadow (1980) hypothesized that when deaf children go to school, their teachers may lower their expectations out of frustration because of the students' low achievement; this may create a vicious circle leading to fewer and fewer opportunities for mediation and stimulation of cognitive potential (Keane, 1985).

The likelihood that adequate mediated learning experiences will be provided to hearing impaired children seems to be quite limited when communication deficits leave such a scar on the child rearing

practises of parents of hearing impaired children (Vernon, 1974; Stein, Mindel, & Jabaley, 1981; St. Claire-Stokes, 1984).

It is important to note that one subgroup of hearing impaired children repeatedly outperforms other subgroups. Research consistently documents the superior academic performance (Brill, 1960, 1970; Quigley & Frisina 1961; Vernon & Koh, 1970) and social development (Stuckless & Birch, 1966; Meadow, 1968; Harris, 1978b) of deaf children of deaf parents both from families who use sign language as well as those who use speech. It is interesting that despite equally severe hearing losses, differential development by this subgroup is marked. Though deaf children of deaf parents do not in general reach the same levels as hearing children, particularly with respect to academic development, the gap between potential and performance is much smaller than that observed in hearing impaired children as a group. These findings would lend support to Feuerstein's theory that distal factors, such as hearing loss, are not the direct cause of retarded performance.

The factors which differentiate deaf children of deaf parentage, from those of hearing parents are very complex. One important area of difference, however, is in early two-way communication which appears to be facilitated by the ease with which hearing impaired parents adjust to having a hearing impaired child. It is

this factor which may greatly contribute to the documented superiority of these hearing impaired students over the others.

Harris (1978a) explored this factor as related to impulse control and reported that deaf children of deaf parents were consistently superior to deaf children of hearing parents with respect to impulse control on the Draw a Man and Matching Familiar Figures Tests. Harris inferred that his results may reflect that the early two-way communication experienced by children of deaf parents helped them to develop cognitive and syntactic structures that lead to an ability to modulate impulses more constructively (Harris, 1978a).

Studies into the differences in development between deaf children of deaf parents and deaf children of hearing parents provides further evidence of the importance of language in the cognitive and social development of young hearing impaired children.

There is clearly some evidence, which considered in the light of Feuerstein's theory, could logically explain the differences in development of deaf children of hearing parents as opposed to those of deaf parents by way of adequacy of mediated learning experiences. It is possible that the early two-way communication between parent and child has set the stage for a deaf child to obtain more adequate learning experiences. The experiences may well have resulted in a smaller gap

between potential and performance. One must be somewhat cautious in drawing such a conclusion at this point due in part to the multiple effects of some causes of deafness which may not be present in hereditary causes of deafness. It is however, a potentially useful explanation which warrants further exploration.

Summary of Research in Deafness

The literature aptly portrays the hearing impaired adolescent as being at risk for becoming a retarded performer. Despite observing the normal range of intelligence in hearing impaired students, levels of academic achievement are disproportionately low. Explanation of the disparity between potential and performance of hearing impaired students was explored through the literature on the relationship of thought and language. Unfortunately, even yet, very little is known of their relationship.

Perhaps a more useful description of the relationship of thought and language will be gained from viewing the work of Furth and Vygotsky not necessarily as conflicting theories, but as complementary explanations of the same phenomenon. Both are required to explain how thought, language and experience enhance and transform one another. Regardless of one's theoretical preference, it appears that a language deficit may be a very severe handicap to academic, intellectual, and social development.

From the literature, the potential exists to logically infer that, like Feuerstein's students, hearing impaired children frequently may not receive adequate mediated learning experiences and thus become retarded performers. It is this logical inference which provides the bridge across which Feuerstein's theory, and related program, may be transported for application to hearing impaired children. It is also this inference which provides the rationale for investigating the use of Instrumental Enrichment with hearing impaired children.

C. Cognitive Education

Research in Instrumental Enrichment

Though Instrumental Enrichment was originally designed for use with culturally deprived adolescents showing retarded performance, it has since been recognized as having potential applications for a much wider spectrum of students (Sternberg, 1984). The use of Instrumental Enrichment is now being investigated with populations including the learning disabled (Harth, Johns, Cloud, & Campbell, 1981; Haywood & Arbitman-Smith, 1981), the educably mentally retarded (Haywood & Arbitman-Smith, 1981), the behaviorally disordered (Haywood & Arbitman-Smith, 1981), English as a second language (Luther, 1982), and hearing impaired students (Martin, 1984, 1985a; Jonas & Martin, 1985).

In reviewing the literature on the use of Instrumental Enrichment it was observed that the number of published studies was extremely limited. In contrast, Link (1980) refers to commitments in the United States made by 43 school districts from 10 different states in which districts have committed themselves to two and three year programs. It would appear that published research is reporting on but a miniscule proportion of the classrooms actually involved in piloting Instrumental Enrichment programs.

The literature review which follows consists of three sections. First the pioneering work of Feuerstein and his colleagues is reported in some detail. These findings involve the "culturally deprived" adolescent for whom the program was originally designed. The results of studies investigating application of Instrumental Enrichment to other populations are summarized. Finally, the work of Martin (1984) and Jonas and Martin (1985), which ran concurrent to this research, is also reviewed.

Use of Instrumental Enrichment with the Culturally Deprived

The primary objective of Rand, Tannenbaum, and Feuerstein's (1979) study involving 218 adolescents was to determine whether or not participation in 300 hours of instruction in the Instrumental Enrichment program resulted in better performance than did participation in a supplementary academic instructional plan known as the General Enrichment (GE) program. The following areas were studied over a two year period:

1. general and specific cognitive tasks
2. scholastic achievement
3. self concept
4. classroom interactions

The subjects were "characterized as disadvantaged, socially backward, and culturally different and as members of minority groups" (Rand, Tannenbaum, & Feuerstein, 1979, p.753). According to these researchers, although the general enrichment and Instrumental Enrichment subjects were matched on P.M.A. total score, some significant pretest differences were observed in specific P.M.A. subtests and in academic achievement.

First, the IE group showed significantly greater gains than the control group on the tests of general and specific cognitive functions.

Second, the IE students showed a slight advantage over the controls in the academic area even though GE students had received 300 additional hours of course work and were initially performing at a higher level. In most instances the IE group closed the gap which initially existed between performance of IE and GE subjects but this gain was not statistically significant except on two subtests (Bible and Geometry).

Third, no significant differences were noted in performance on the Levidal Self Concept Scale even on the failure, motivation, or personal success items the authors had expected to show differentiation.

Fourth, with respect to classroom interactions the IE group showed statistically significant gains on the Classroom Participation Scale II with major effects being observed on all three factors (Interpersonal Conduct, Self Sufficiency, and Adaptiveness to Work Demands). These results lead the authors to conclude that:

> a) mediating basic deficiencies in problem solving can produce better results than do tutorials in school subjects and b) it is not too late to intervene with adolescents who are failing in school. (Rand, Tannenbaum, & Feuerstein, 1979, p.751)

Two years later 164 of the original 218 subjects were tested as part of their army enlistment procedure (Feuerstein, Miller, Hoffman, Rand, Mintzker, & Jensen, 1981). The experimental group had an average DAPAR of 5.38 whereas the control group scored an average of 4.64. The two year period of nonintervention did not wipe out the beneficial effects of I.E. The experimental group had maintained their advantage even two years later and continued to be differentiated.

Feuerstein et al. (1981) acknowledged that the results of one intelligence test is meager evidence of structural cognitive change. However, it was pointed out that this measure did carry considerable weight in that scoring within the normal IQ range made the subjects eligible for opportunities that would otherwise have been denied them.

Bradley (1983) attacked Feuerstein's claim that his research lent substantial support to the hypothesis that Instrumental Enrichment leads to better intellectual and academic peformance. Bradley found this claim highly questionable since cognitive gains on the Primary Mental Abilities Subtest were relatively insignificant and on at least one subtest (Spatial Relations) a practice effect was possible. No discussion of the tests' standard error of measurement was provided and because of Feuerstein's large sample "...the power [was] available to produce statistical significance even if

the differences among the means [was] trivial...". (Bradley, 1983, p.84). Feuerstein had not provided the reader with a perspective to permit differentiation between statistical significance and "real life" significance. According to Bradley, the reported gains in intellectual capacity were also suspect since contrary to what one would have suspected, no gain in school performance accompanied the intellectual gain.

Use of Instrumental Enrichment with Other Populations

Generally, researchers applying I.E. to other populations, including learning disabled (LD), educably mentally retarded (EMR), and behaviorally disordered (BD) students have obtained essentially similar results to those obtained by Feuerstein. From these studies four main conclusions can be drawn.

First, there was observable improvement in the performance of specific cognitive and academic tasks among learning disabled students with the inclusion of written mediational instructions into the students' worksheets (Harth et al., 1979), and with hearing impaired students after only 30 minutes of task specific mediational instruction (Huberty & Koller, 1984). These results appear to support Feuerstein's conclusion that adolescents are amenable to change by mediating to deficiencies.

Second, research consistently documented significant improvement in nonverbal reasoning after two years of I.E. in low functioning culturally deprived adolescents (Rand et al., 1979; Feuerstein et al., 1980b) and in some cases after only one year among vocational high school students (Narrol et al., 1982) as well as among LD, EMR, and BD students (Haywood & Arbitman-Smith, 1981). These results were based on administration of measures such as Raven's Standard

Progressive Matrices, the Spatial Reasoning and Picture Identification Subtests of the Hiskey Nebraska Test of Learning Aptitude, Lorge Thorndike and Primary Mental Abilities Test.

No attempts have been made to replicate the additional conclusion that intellectual gains made by I.E. students are maintained even after a two year period of nonintervention (Feuerstein et al., 1981).

Third, findings in the area of academic achievement have been mixed. I.E. subjects, in some studies, have demonstrated gains after two years of I.E, programming, but these gains have not been consistently statistically significant among culturally deprived students (Rand et al., 1979) and among LD, EMR, and BD students (Haywood & Arbitman-Smith, 1981). Results in this area were based on the administration of measures such as the Peabody Individual Achievement Test, Wide Range Achievement Test, and Key Math.

This relative lack of change observed in scholastic achievement by many researchers lead investigators to ask themselves if standardized tests were appropriate for measuring the changes which seemed already to have occurred. Arbitman-Smith and Haywood (1980) concluded that it would appear that standardized tests may be within a region which was currently too remote for transfer.

In the same paper Arbitman-Smith and Haywood reported data based on clinical method interviews used to gain insight into the way in which students defined the problems to be solved and the problem solving process they employed. The students were asked questions based on test items that they had failed to correctly answer. According to Arbitman-Smith and Haywood (1980) "examining children on how they came up with answers may be one of the best sources of such understanding". (p.62)

Fourth, researchers have investigated whether or not changes in personality occurred either with or without changes in cognitive performance. Studies have consistently been unable to detect changes in general self concept or attitude toward school even after two years of programming involving culturally deprived adolescents (Rand et al., 1979) and EMR, LD, and BD adolescents (Haywood & Arbitman-Smith, 1981) as well as Ontario vocational high school students (Narrol et al., 1982). These results have been based on administration of such instruments as: Levidal Self Concept Scale, Piers-Harris Self Concept Scale, School Morale Scale, and Choice Motivator Scale.

In light of conflicting anecdotal reports from teachers, these results have lead the authors to question the sensitivity of standardized measures such as the Piers Harris in detecting the changes they wished

to document. In addition, this finding was explained as a function of the resistance personality factors show to change particularly in initial stages of change. A latency period was proposed after which time attitudinal factors might show change:

> It may be necessary for the new-found thinking habits to become well established before the individual begins to believe in himself or herself as a "thinker". Perhaps measurable changes in self concept occur from this point of "belief" on, and thus, are not evident until some time after the point is reached. (Narrol et al., 1982, p.111)

Fifth, results have been positive, but not consistently significant, with respect to documentation of behavioral differences between experimental and control subjects based on the use of checklist and questionnaire types of instruments (Arbitman-Smith & Haywood 1980; Haywood & Arbitman-Smith 1981; Narrol et al., 1982). Clearly however, these instruments have been more sensitive than standardized measures of personality and attitude. In their examination of vocational high school students Narrol et al., (1982, p.111) reported anecdotal documentation of changes related to:

1. more positive personal development
2. decrease in aggressiveness with peers

3. decrease in disruptive class behavior
4. increase in interest shown in work
5. increase in intrinsic motivation

Use of Instrumental Enrichment with Hearing Impaired Populations

Though there is very little research involving hearing impaired adolescents, the results of three studies, running concurrent to this research, are now available (Martin, 1984, 1985a; Jonas & Martin, 1985). Results published have been particularly positive. Martin (1985a) observed that on a self rating scale hearing impaired college students participating in I.E. reported self perceived improvement related to increased reflectivity and planning as well as improved ability to follow instructions and self correct errors. Jonas and Martin uncovered five key findings based on their work with students from the Model Secondary School for the Deaf. At the end of two years of programming their 39 I.E. subjects had made several important changes:

1. I.E. students demonstrated improvement in problem solving interviews with respect to practicality, completeness, organization, and planning and on one item related to a deaf friend becoming seriously ill at a restaurant significance was reached ($p < 0.01$).
2. I.E. students showed significant improvement in nonverbal reasoning as measured by Raven's Standard Progressive Matrices ($p < 0.02$).
3. I.E. students had become increasingly demanding

of precision in themselves, described multiple strategies, and defended their own opinions with logical evidence as demonstrated through teacher checklists.

4. I.E. students made significant gains in Reading Comprehension on the SAT-HI ($p < 0.05$). This gain was explained by the focus on making comparisons and projecting relationships in the I.E. program.
5. I.E. students made significant gains in Mathematics Computation and Mathematics Concepts on the SAT-HI ($p < 0.05$). Martin explained the favorable change as the result of factors such as increased precision, impulsivity restraint, and self checking behavior emphasized in I.E. programming.

Martin's positive results lead him to conclude that systematic cognitive intervention should be an important part of ongoing school curriculum and that adolescence is not too late to make significant and measurable changes in cognitive performance. Importantly, given the magnitude of his samples, he also concluded that larger student samples and more complex research designs were required to document the statistical effects of Instrumental Enrichment intervention with hearing impaired students.

In summary, despite the nearly 30 year history of Feuerstein's work in the area of cognitive education, relatively few studies have been published. Of those available, a recurring pattern of conclusions in two areas have emerged. First, findings regarding student change have been quite consistent with a variety of exceptional populations. Second, conflicts between anecdotal data and standardized measures have lead researchers to question the sensivity of such measures in detecting and documenting the changes which appeared to have already occurred.

III. Design and Methodology

A. Rationale and Design

Review of the literature reveals that research into the use of Instrumental Enrichment is currently investigating changes in cognition through the use of experimental designs and standardized tests (Rand et al., 1979; Haywood & Arbitman-Smith, 1981; Narrol et al., 1982). Largely it is the product of cognition which is being studied; little is being done with respect to getting closer to how these products are generated. Data regarding the cognitive process is reported primarily as an aside when statistically significant changes in the product are not detected, or to support those which are detected (Haywood & Arbitman-Smith, 1981; Narrol et al., 1982; Martin, 1984; Jonas & Martin, 1985).

According to Arbitman-Smith and Haywood (1980), the problems associated with using standardized tests to detect changes in cognitive performance are not new:

> First, it is not clear which of the measures we are using actually measures what the program is designed to teach, i.e. basic cognitive skills. Secondly, what we want to find out is not only how many points students have gained on various measures ... but also the specific processes they learned and then used in solving different types of problems. (Arbitman-Smith & Haywood, 1980, p.57).

From the literature, it seems to be clear that new instruments are required which are more sensitive both to detecting the changes in the cognitive processes which may occur in I.E. students, as well as to detecting how and when these skills become transferrable to problems outside of the Instrumental Enrichment program (Arbitman-Smith & Haywood, 1980). It was from such a "process" orientation that the design of this study was derived. This research was descriptive rather than experimental, and the primary source of data were observational rather than standardized measurements. The design of the research was based on the following theoretical principles (Bogdan & Biklen, 1982, p.55):

1. Evolving questions should be one of the products of data collection rather than its precursor.
2. Meaning and process are crucial to understanding human behavior.
3. Data should be descriptive in nature.
4. Analysis of qualitative data is best done inductively.
5. Traditions of data collection include direct observations, open ended interviews, and participant observation.

It was the intent of this researcher to describe changes in the cognitive processes of adolescents participating in

Instrumental Enrichment programming by focusing on the behavioral aspects of the process itself. Changes in the products of cognition, or test scores, were used to support documentation of the changes in process rather than the reverse.

It should be noted that the "microchanges", or qualitative changes in cognitive functions and strategies underlying a change in level of performance may be apparent long before solid quantitative evidence of change in level of performance can be documented. It is important, however, not to underestimate the significance of these behavioral changes or microchanges. In light of research in deafness discussed in chapter two, and the fact that after only one year of I.E. large changes cannot be expected in this population, these microchanges are in fact very noteworthy.

In addition to taking a process approach to the problem under investigation, this study capitalized on the role of the teacher as a researcher and participant-observer. Spradley (1980) identified six key parameters upon which to found one's choice of research site - simplicity (single setting), accessibility, unobtrusiveness, permissibility, opportunity for participation, and frequency of occurrence of the activity. Based on Spradley's advice it appeared that teachers in their own classes are provided with excellent opportunities for doing research; all of Spradley's parameters are already satisfied by the role of the teacher upon which the researcher role can then be superimposed. In

addition to classrooms providing good research sites to teacher-researchers, three beneficial outcomes to the teacher's role as participant-observer in his or her own classroom can be identified. First, the participant-observer is placed in an advantageous position when the question all observational researchers ask themselves must be answered; "Am I observing the things I should be - the important events?" According to Spradley (1980) one way for the researcher to be certain of focusing on important events is by consulting informants (or research subjects) to find out what the important events are. "More often than not, informants can identify urgent research more clearly than the ethnographer". (Spradley, 1980, p.18). By making use of systematic observational strategies beginning with general descriptive observations and then progressing to focused and finally selective observations, participant-observers place themselves in the role of informants and thereby gain important knowledge to help them define what is important and what is not.

Second, the relationship between the participant-observer and those being observed can be a valuable tool in minimizing the "observer-effect".

> The more controlled and obtrusive one's research the greater the likelihood that one will end up studying the effects of one's methods. If you treat people as "research subjects" they will act as research subjects which is different from how they usually act. (Bogdan & Biklen, 1982, p.43).

Because of the teacher-student relationship, the teacher as a researcher easily blends into the environment allowing a better opportunity to see students as they usually act.

Finally, the teacher's intimate knowledge of the situation allows him or her to generate additional insights. In a sense, this unique opportunity offers teacher-researchers a way of seeing school experiences through the eyes of their students by allowing the students to become their teachers. When making descriptive observations, teacher-researchers participate in a social situation and then treat themselves as informants (Spradley, 1980). Teachers as researchers can observe their students and learn from them but can also learn by observing themselves as they go about being educators.

Because this researcher is also a classroom teacher using I.E. with hearing impaired adolescents, this opportunity to assume the dual role of teacher and researcher was seized. This researcher's classroom provided an excellent research site according to Spradley's

criterion. As well, it afforded this researcher the tools with which to determine what information is important and what is not, to minimize the observer effects, and to use the knowledge gained through the experience of being both an insider and an outsider to I.E, to gain new insights into the use of I.E. with hearing impaired adolescents.

The remainder of this chapter is devoted to a discussion of the implementation of this approach to the investigation. Following is a description of the subjects involved. Secondly, a discussion of the instruments used and the rationale behind their selection is included. Emphasis is given to anecdotal observation, and open-ended interviews investigating students' strategies. Finally, a description of the testing and programming procedure is presented.

B. Subjects

The I.E. group, comprised of four students, was formed on the basis of student interest in piloting a "Thinking Skills" course of study for hearing impaired adolescents which was based on Feuerstein's Instrumental Enrichment program. The four students were given five credits toward their high school diploma for doing the course.

The I.E. students varied in age from 18-0 to 18-8 years of age. Their hearing losses ranged from moderate to severe (67-100 dB) and were bilateral sensorineural in nature. The hearing losses, in each case, were of prelingual onset and had necessitated the students' participation in special

segregated programming for hearing impaired children through their elementary and junior high years. The four students continued to require special segregated programming in English in lieu of participating in their high school's mainstream English program. This small group instruction was provided by this researcher who was also the teacher of the hearing impaired and the I.E. instructor at the high school.

The regular program group consisted of the three remaining students serviced by the Hearing Impaired Program. These students took one of the several other five credit options offered at the school in lieu of Instrumental Enrichment. The three regular program students were similar to the I.E. students with respect to their age, onset and degree of hearing loss, as well as their continuing need for special programming at the high school level. The reader is referred to Appendices C and D for a more complete description of each of the I.E. and regular program students.

An opportunity to study changes in the cognitive functioning of these two preformed groups of hearing impaired adolescents became available in September, 1983. This study capitalized on that opportunity.

C. Intervention Instrument and Methodology

Survey of Cognitive Education Programs

The concept of cognitive education is not a new one. For nearly two decades individuals such as DeBono (1976) and Feuerstein (1980b) have been engaged in the development of materials and active promotion of the idea that thinking can, and should, be directly taught.

The selection of cognitive education programs which can easily accommodate the special needs of hearing impaired adolescents who are also retarded performers is very limited, though a multitude of programs and activities have become available to classroom teachers. From among those programs available, the following five have gained recognition in the literature addressing cognitive education (Sternberg, 1984; Narrol & Giblon 1984):

1. Philosophy for Children (Lipman, Sharp, & Oscanyan, 1978)
2. Chicago Mastery Learning Reading Program (Jones, 1982)
3. Analytical Reasoning (Whimbey & Lockhead, 1980)
4. Cognitive Research Trust (CORT) (DeBono, 1976)
5. Instrumental Enrichment (Feuerstein et al., 1980b)

None of the five programs have, by design, included the hearing impaired adolescent as part of the intended audience. Because of the unique needs of the hearing impaired adolescent, difficulties are encountered if one tries to apply a program which is not sensitive to this

group's needs. Attempts to compensate for the hearing impaired student's deficits in vocabulary and concept development by selecting materials based on reading level rather than chronological age leads to a mismatch with respect to motivational factors. By contrast, if one attempts to select a program based on chronological age, so as to ensure motivational factors are appropriate, the hearing impaired students are likely to encounter serious difficulty with respect to vocabulary and concept development as well as reading level.

Appendix E surveys each of the above mentioned programs for its capacity to accommodate the special needs of hearing impaired students. The comparison is provided to emphasize the close match obtained between the intended audience of Instrumental Enrichment and the characteristics of hearing impaired students discussed at length in chapter two.

Rationale for Selecting Instrumental Enrichment

The rationale behind using Instrumental Enrichment with hearing impaired students is based on four propositions. First, Instrumental Enrichment was originally designed for use with adolescents showing retarded performance due to cultural deprivation. Earlier, a case was built for perceiving the hearing impaired adolescent as a retarded performer. Like Feuerstein's intended audience, the hearing impaired adolescent demonstrates a gap between intellectual potential and realized academic and social achievement

(Gentile & DiFrancesca, 1969; Harris, 1978) and therefore logically may already be a member of the audience for whom Instrumental Enrichment was designed.

Second, the materials on which the I.E. program is based are largely nonverbal. Many of the first year instruments are easily accessable to near nonreaders and intrinsically motivating to children of many ages (Sternberg, 1984). This resolves the mismatch of reading age and chronological age posed by the application of other cognitive education programs to hearing impaired adolescents.

Third, very few assumptions are made regarding the entry behavior of students. Vocabulary and concepts required in the program are systematically developed through the course of study. Strategies for teaching required concepts are incorporated in the teacher manual of lesson plans. Because of this sensivity to entry behavior and verbal skills, hearing impaired students are easily accommodated.

Fourth, according to Sternberg (1984) Instrumental Enrichment has probably been the most widely used and field tested program both in the United States and elsewhere. This is another important factor in making I.E. a good choice though actual published research is disappointingly scarce.

Programming Methodology

The I.E. group took part in Instrumental Enrichment programming for 40 minutes daily from October to May. The

course was instructed by this researcher who was also the Teacher of the Hearing Impaired. In total, the I.E. students participated in an average of 100 hours of instruction. Some slight variation occurred at times through the year as each of the I.E. students was away from school for two weeks on work study as part of their vocational program. During the programming period, the group completed the first four instruments comprising Feuerstein's Level I Instrumental Enrichment Program. For a description of these instruments the reader is referred back to Appendix B.

Two basic clarifications must be made with respect to teaching methodology and use of this program. First, the I.E. instruction manual provided a resource of possible vocabulary, concepts, principles, and bridges from which it was necessary to select that which was most appropriate and relevant to the students needs. It was not simply a series of rigid lesson plans to be taught. As a result, no two teachers would make exactly the same choices.

Second, there was a dilemma to be faced in juxtaposing the visual, and often concrete, needs of hearing impaired students and the verbal-abstract nature of the program. The dilemma was resolved by compromise. Very extensive use was made of an overhead projector to display the page as well as relevant notes and diagrams evolving from the discussion. Whenever it became necessary to concretize or nonverbally represent an idea in order that the students would understand, an immediate return was made to examining the

same information through more verbal-abstract means. Care was taken to ensure that little or no compromise was made in the intent of the program.

While the I.E. group participated in Instrumental Enrichment, the regular program students participated in the option course of their choice for the same period of time. Like the I.E. students, the regular program group members were also away from the school for a two week work study participation.

D. Data Collection Instruments and Methodology

Data were collected by means of three major processes:

1. Anecdotal Observation
2. Open Ended Strategy Interviews
3. Administration of Standardized Measures

Following is a discussion of these processes and the related instruments.

Anecdotal Observations

General Purpose and Rationale

The rationale behind the use of anecdotal observation as a means of investigating changes in self regulatory behaviors was based on three main arguments.

First, it was anticipated that the anecdotal observations would provide a sensitive indicator of changes in strategies which may have been too immature

to be reflected as changes in level of performance.

Second, the anecdotal data was intended to be collected on an ongoing basis rather than being restricted to defined testing periods. It was therefore anticipated that the anecdotal observations would provide data which reflected a broader context with respect to time and setting than the data obtained through the other instruments.

Third, the anecdotal data were intended to serve as the primary index of significance of change with respect to self regulatory behaviors. Because the anecdotal data were based on real life problem solving situations faced by adolescents, rather than artificial test conditions, it was believed that this method would provide opportunities to explore the degree to which changes in self regulatory behaviors had been generalized for use outside of I.E. class.

Methodology for Anecdotal Observations

Given that qualitative information related to changes in self regulatory behaviors was of interest, the following procedure was developed through which detailed sequential information could be gained.

A daily log was kept based on the first hand observations made by the I.E. teacher as well as the Speech/Language Pathologist. In addition, any observations made by the students' other teachers were

also recorded. Each log entry consisted of the date, time, explanation of the situation or context as well as a description of the student's behavior. To the extent it was possible, student comments were recorded verbatim.

Data were collected in four discrete contexts for the purpose of investigating generalization of behaviors. The contexts included:

1. During the I.E. Class instruction by teacher
2. During Speech/Language instruction by speech/language pathologist
3. During interaction with teacher, speech/language pathologist, or students outside of I.E. class instruction
4. During mainstream class instruction by various teachers

Special attention was paid to changes in self regulatory behaviors such as:

1. Planning behaviors
2. Restraint of impulsivity
3. Student responsibility for learning
4. Demand for precision in self and others
5. Demand for logical evidence in self and others

In acknowledgement of the potential difficulties in reliability and validity faced by a researcher collecting his or her own data through anecdotal observation, three monitoring procedures were

incorporated. These procedures were based on the coordination and comparison of multiple sources of data within a broader context.

1. Comparison of anecdotal observations made by the researcher with those made by the Speech/Language Pathologist
2. Comparison of anecdotal observations made in this study to those reported in the literature on Instrumental Enrichment
3. Comparison of anecdotal observations made in this study to data collected through the use of other instruments
4. Comparison of anecdotal observations to I.E. class tapes made throughout the year

Open Ended Strategy Interviews

General Purpose and Rationale

Teacher made reading closure activities were selected to probe for changes in the child's ability to verbalize his or her strategy for solving verbal problems. The rationale for using the reading closure activities was based on its dual role. It was intended that the activities would explore metacognitive involvement, but in the context of reading comprehension data may also lead to insight into functions underlying the students' reading performances. The tasks were specifically

designed to investigate these variables and the materials and the procedures were developed for the research subjects involved.

Description

Each of the three activities began as a short selection of 100 - 150 words about a familiar topic such as fishing, colds, or soft drinks. A maximum of ten different words, as well as all recurrances of those ten words were deleted. The blanks were coded using the numbers one to ten to indicate where the same word recurred and where a new word was required. A sample activity is provided in Appendix F.

Measures were taken to ensure that the information gained from this instrument would be as conclusive as possible. Materials were selected which were well within the reading ability of all subjects and assistance was provided as required in completing the closure task. The activity was administered to all subjects by the teacher who had a rapport with the students which ensured optimal two-way communication. The subjects had at least two opportunities as they worked through the activity to formulate their strategy statement. This procedure was intended to increase the likelihood of observing their best performance. The activity was audiotaped and transcribed verbatim to ensure greatest accuracy.

Methodology for Verbal Problem Solving Tasks

The reading closure tasks were individually administered by this researcher three times throughout the year (September, April, June). Prior to the activity, each student was shown the exercise and asked to state their strategy for completing the task. The students were then asked to begin working aloud with the teacher. Assistance was provided as necessary to help the students complete the exercise. Part way through, and also at the end of the exercise, the students were asked to explain their strategy as completely as possible using sentences.

Standardized Measures

To complement the primary data from the anecdotal observations and open ended strategy interviews, six standardized measures were choosen as secondary data sources through which to pursue the transferability of the changes observed in cognitive processes. In the following section, a brief overview of the purpose of each test and the rationale for selecting it are presented. The procedures for collecting these data are also discussed.

General Purpose and Rationale

Raven's Standard Progressive Matrices

Raven's Standard Progressive Matrices was chosen to assess changes in nonverbal reasoning skills as well as strategies. According to Raven (1960) the test was developed to measure the subject's capacity to evolve a systematic method of reasoning. The test was therefore a particularly relevant and appropriate instrument for use in this research for two basic reasons.

First, because of the purpose of the test, success was likely to be influenced by self regulatory behaviors such as systematic work or restraint of impulsivity and therefore the measure may be sensitive enough to reflect changes in performance linked to changes in self regulatory behaviors (Martin, 1984).

Second, the test required no modifications in administration to accommodate this population (Zieziula, 1982) and had been used successfully with hearing impaired populations (Levine, 1974; Carlson & Dillon, 1978; Zieziula, 1982; James, 1984; Martin, 1984).

Canadian Tests of Basic Skills

The Mathematics Problem Solving Subtest is one of eleven subtests comprising the Canadian Tests of Basic Skills battery and is designed to determine the student's developmental level and to diagnose strengths and weaknesses. The mathematics problem solving subtest, consisting of 27 multiple choice problems, was selected for use in this research for three basic reasons.

First, it appeared to provide a suitable vehicle through which to investigate whether or not strategies and planning behavior anticipated to develop among I.E. students would generalize to a field of content into which little bridging occurred.

Second, because the test was intended to be administered repeatedly to determine the degree and the rate of change, the availability of a reliable and valid test having equivalent forms was critical.

Third, the accessability of achievement tests normed for hearing impaired adolescents was limited; research indicates that the Stanford Achievement test is the only one available. Given these factors, the CTBS provided the best alternative.

Edmonton Public Schools Elementary Reading Test

Edmonton Public Schools Elementary Reading Test was designed by the Pupil Assessment Branch of Edmonton Public Schools (1980) to assess specific reading skill areas. From this instrument, three subtests were chosen. The Literal Comprehension subtest is composed of 30 items and requires the student to locate and recall details, directions, and sequence of events, as well as relationships.

Inferential Comprehension consists of 22 items requiring the student to infer relevant details and sequence of events, to identify main ideas, subordinate ideas and relationships, and to infer mood. The student's ability to make generalizations and predictions as well as to draw conclusions is also examined.

Critical Comprehension is composed of 18 items requiring the student to detect absurdity, to detect ways in which character traits, attitudes, and feelings have been revealed, and to discriminate between fact and opinion as well as essential and non-essential detail.

The final three subtests of the EPS Elementary Reading Test were selected for use in this research for two basic reasons.

First, this researcher wished to explore whether or not one type of reading comprehension was more significantly affected during Instrumental Enrichment programming than others. The EPS Elementary Reading Test examines and quantifies the students' comprehension based on the three parameters of interest - literal, inferential, and critical reading. These first two parameters closely parallel the types of thinking skills emphasized in Instrumental Enrichment Programming and therefore it was believed that the subtests would be sensitive to changes in thinking and self regulatory behaviors also required in reading comprehension.

Second, though research indicates the existence of the SAT-HI (Martin, 1984) reading comprehension subtest for the hearing impaired, it does not readily display the capabilities of interest. The EPS instrument was therefore the best alternative available.

Student's Perception of Ability Scale

The Student's Perception of Ability Scale (Boersma & Chapman, 1977) was selected for the purpose of investigating changes in the students' perceptions of themselves as "thinkers" and "problem solvers". According to Boersma and Chapman (1977), the SPAS was developed to facilitate research into the role of academic self concept in achievement among elementary school age children. The test is composed of 70 forced choice yes/no items, chosen to represent the student's feelings toward the five major academic areas (reading, spelling, language arts, arithmetic, and penmanship) in addition to school in general. The instrument was selected for two main reasons.

First, it was anticipated that because this test was designed to investigate the relationship between perception and performance, it would also be sensitive to changes in the students' perception of themselves as competent problem solvers in an academic setting.

Second, although designed and normed for use with upper elementary age hearing children rather than hearing impaired adolescents, its controlled syntax and vocabulary made it comprehensible to the hearing impaired adolescent without administrative modification. Better alternatives were not available.

Clinical Evaluation of Language Functions-

Developed by Semel and Wiig, (1980), the general purpose of the eleven subtests of the Clinical Evaluation of Language Functions (CELF) is to probe language processing and production abilities of school age children. Subtests one to six evaluate processing and require recognition, interpretation and/or recall. The student is required to respond by pointing, saying yes/no, or answering wh- questions. (Processing subtests include: Word and Sentence structure; Word Classes; Linguistic Concepts; Relationships and Ambiguities; Oral Directions; Spoken Paragraphs).

Subtests seven to eleven evaluate production and require active naming, word or sentence recall as well as sentence formulation and production. (Production subtests include: Word Series; Names on Confrontation; Word Associations; Model Sentences; Formulated Sentences).

The rationale behind selecting the CELF test for use in this research rests on four basic principles.

First, the CELF appeared to be a test which would be sensitive to changes in cognitive functions related to the input and output phases of language use.

Second, because the test analysed student language use in terms of eleven separate language functions, it provided a fine grained analysis of changes within the student's processing and production skills. It was anticipated that some language functions would be more greatly affected than others and that this test would aid in defining those areas.

Third, though the test was not normed for hearing impaired adolescents, it was normed to include 18 year old students thereby providing a framework through which to define for the purposes of this research what constituted "clinically significant gain".

Fourth, the test was also a routine component of the Speech/Language Pathologists' assessment procedures.

There are some weaknesses in this instrument which came to light during the study. This problem is discussed in more detail in the next chapter.

Developmental Sentence Scoring of Spontaneous Language

Developmental Sentence Scoring (DSS) is a method for making a detailed and quantifiable evaluation of a child's use of standard English grammatical rules from an audio tape recorded sample of spontaneous speech in conversation with an adult (Lee 1974). The procedure samples the child's expressive language capabilities and calculates the grammatical load carried by each sentence with respect to eight categories of structures.

The rationale behind the use of Lee's Developmental Sentence Scoring procedure was based on three factors. First, it was believed that the categories of the analysis would be sensitive to the anticipated changes in precision and elaboration of expressive language. Second, because the analysis was based on spontaneous language rather than test stimulated language, the procedure, when coupled with CELF test results, may assist in determining whether or not any truly meaningful changes occurred in the students' "real life" use of language in problem solving contexts. Third, this procedure of analysis has been used successfully with hearing impaired subjects (Bernice Ryan: personal communication, July, 1981).

Methodology for Standardized Measures

Phase 1 Testing

The six standardized measures were administered beginning in mid September. Four of the six tests were written group tests and included:

1. Raven's Standard Progressive Matrices
2. Edmonton Public Schools Elementary Reading Test - Literal, Inferential, and Critical Comprehension Subtests
3. Canadian Tests of Basic Skills - Mathematics Problem Solving Subtest
4. Student's Perception of Ability Scale

The above mentioned written tests were administered to the students by this researcher during the time in which the students were scheduled to take English. The standardized procedures for each instrument were followed.

The two remaining instruments composed the second test battery:

1. Clinical Evaluation of Language Functions
2. Spontaneous Language Sample analyzed by Lee's D.S.S. procedure

Like the instruments comprising the written battery, the above mentioned instruments were administered during the month of September or early October.

The Clinical Evaluation of Language Functions was administered individually to each student by the school's Speech/Language Pathologist. This test was given as a routine component of the pathologist's assessment procedures. The procedures for administering the test, as outlined in the test manual were strictly followed. Other than careful selection of a suitable testing environment which facilitated the students' use of residual hearing and speechreading, no modifications were made to the test administration procedures.

The language sample was collected by this researcher who was also the students' English teacher. The stimulus materials consisted of adult puzzles such as Rubik's Cube, Magic Squares and a number of wooden puzzles also requiring one to disassemble the pieces and reassemble them to form the complete whole. No deviations were made from the standard procedures outlined by Lee (1974).

During the pretest period, students were informed that the purpose of the study was to find out more about how students learn. Emphasis was placed on the need for honest responses and best efforts in both written and oral tests if the research was to be valuable. The students were also informed that all of the test information was confidential and would not be released to parents or

other teachers. Pretesting was concluded at the end of September.

Phase II and III Testing

At approximately equal intervals, during January and April, phases two and three of testing occurred. Several of the tests comprising the oral and written pretest batteries were re-administered to provide more data points so that trends could be more confidently identified. These tests were selected because they were relatively quick to administer and would provide minimal disruption to programming. More importantly, it was felt that these instruments would be sensitive enough to identify small changes. Those instruments re-administered in phases two and three of testing were:

1. Student's Perception of Ability Scale
2. Canadian Tests of Basic Skills - Mathematics Problem Solving Subtest

The Spontaneous Language Sampling Analysis was only administered once during the phase II and III periods (in February) because of its very time consuming nature.

Phase IV Testing

During the month of June the full oral and written

pretest batteries were re-administered. Thus, by the end of the study period, four measurements had been taken with both I.E. and regular program students for academic self concept and math problem solving. Three measures of spontaneous expressive language were taken. Only pre and post measures were taken for nonverbal reasoning, language processing and production, as well as literal, inferential, and critical reading comprehension.

In summary, this chapter initially discussed the rationale for selecting a qualitative approach to investigating the use of Instrumental Enrichment with hearing impaired adolescents. That rationale was founded on an interest in studying how children generate their answers rather than simply the correctness of the answers themselves. Consistent with the theoretical principles behind qualitative research, the subjects involved were members of two small preformed groups. Discussion of the instruments and methods of data collection gave primary emphasis to observation and open ended strategy interviews. These techniques were chosen for their capacity to provide information as to how subjects approached problem solving within the Instrumental Enrichment tasks and how these approaches may have transferred to other types of problems.

IV. Results and Discussion

As discussed earlier, this study is descriptive in nature owing to this researcher's interest in studying the strategies by which students solve problems and due also to the limited availability of subjects. It should also be noted that there were only four subjects in the I.E. group and three subjects in the regular program group; therefore, this fact must be kept in mind when reading the results of this study.

Quantitative data were collected on several key variables; these data will be presented to complement (and to support where applicable) the qualitative changes within each subject rather than as the central evidence for change. In this chapter special emphasis is given to self regulatory behaviors and problem solving strategies based on data collected through anecdotal observation. Discussion draws heavily on the inclusion of direct quotes and detailed description of the behaviors and strategies of individual students for its evidence. Test score data are used to complement the anecdotal data as a means of examining the transferability of these strategies and behaviors as well as probing for other changes.

The results and discussion are based on the following five major categories of behavioral changes observed in individual students over the Instrumental Enrichment programming period from September to June 1984:

1. Evidence of an increase in planning behaviors

2. Evidence of an increasingly active role in learning
3. Evidence of generalization of Instrumental Enrichment concepts and vocabulary to situations outside of I.E. class
4. Evidence of an increased need for precision
5. Evidence of increased use of logical evidence and logical thought

The following section includes a detailed description of the observed five categories of behaviors and citation of actual examples for the purposes of illustration.

A. Planning and Restraint of Impulsivity

In September, anecdotal observations made by the teacher and the speech/language pathologist revealed that four of the seven students (three of the I.E. subjects - Janet, Ava and Linda, and one regular program subject - Ed) seemed to be similar in that lack of planning behavior and unrestrained impulsivity appeared to interfere greatly with performance. Unsystematic work lead to overlooked tasks and incomplete responses. Due to the fact that these students invested little time to plan before responding, written as well as verbal responses frequently required reformulation. For example, excessive erasing, crossing out, and verbal restarting were observed and reported by the teacher and the pathologist in the students' daily English work.

Impulsivity and unsystematic data gathering seemed to be a serious deficient function for these students. The four subjects appeared to have a marked deficiency at the input level. They did not seem to take in enough information to adequately define the problem or to provide sufficient raw material for a good response. Therefore, regardless of how well the information had been elaborated or how carefully formulated the response, it often was limited by their initial problem at the input level. For example, in responding to comprehension questions such as one given as part of a January 27 assignment (Who would find the title of the short story offensive or shocking? Why?) Janet, Ava, Linda and Ed omitted the "why" part of their answer.

Therefore their responses were limited.

It should be noted, however, that the remaining I.E. student (Sandra) and the remaining two regular program students (Annette and Donna) did not appear to experience comparable difficulties in the area of planning and restraint of impulsivity. These three students seemed to be more reflective both in their oral and written work; they were not as quick to respond nor did they appear to be excessive in their erasings. In fact, Annette and Donna (two of the regular program students) were so "unimpulsive" in their responses to teacher posed questions that, at least once per English class, they pondered so long that neither they, nor the teacher could remember the question any longer.

As early as November, three potential areas of change with respect to planning and restraint of impulsivity were observed among the four individual I.E. students:

1. Fewer erasures
2. A lengthened response time lag between question and answer, and
3. A more systematic approach to daily work

First, as demonstrated in Table 1, a decrease in the percentage of erasures was apparent in the I.E. work of three of the four I.E. students (Linda, Janet and Sandra) illustrated by work done on October 25 and February 23.

TABLE 1

Number of Frames Showing Erasure During the Completion of Two Pages From The Organization of Dots Instrument of Feuerstein's Instrumental Enrichment Program

	Oct. 25 Page 2 19 Frames	Feb. 23 Page 12 13 Frames	Net Change In Percent
Linda	13	3	-45%
Janet	10	2	-38%
Sandra	3	2	-1%
Ava	5	4	+5%

While Sandra showed very little change from her initially low frequency of erasures in September, the 38% and 45% decreases in erasures shown by Linda and Janet were more dramatic. The change was most marked in Linda's case bringing her from erasing in 13 out of 19 frames early in

the Dots instrument to erasing in only three out of 13 frames even though the later page was much more complex. It is interesting to note that Ava's rate of erasing, by comparison, increased by 5%. This would appear to suggest that her strategies for completing the frames had changed very little since October. It would seem that Ava may have been influenced to a lesser degree than the other three students by the hypothesis testing strategies which had been taught as a means of reducing impulsivity.

Linda and Janet appeared to have generalized, for use in English class, overtly taught hypothesis testing strategies from the Instrumental Enrichment class. For example, drawing very lightly, using imaginary lines, writing with the eraser rather than the pencil lead, or drawing in the air were among the hypothesis testing strategies taught. These I.E. strategies for planning and reducing impulsivity were demonstrated by Linda and Janet in the context of daily work in English class when they wrote a word in the air to confirm its spelling or verbalized the answer quietly prior to writing it. It was interesting to note that Linda's English papers also appeared to have a less "smudgy" and erased appearance as reported by the teacher.

Erasure counts made during the completion of the Standard Progressive Matrices as shown in Table 2, did not reveal important decreases in erasures consistent with the hypothesis testing behaviors observed in Janet and Linda.

TABLE 2

Number of Responses Showing Erasure During the completion of Standard Progressive Matrices Out of Possible 60

I.E. Program	September	June	Net Change
Linda	7	6	-1
Janet	2	36	+24
Sandra	0	0	+0
Ava	2	1	-1
Regular Program			
Annette	2	0	-2
Donna	1	4	+3
Ed	0	0	0

While in June, Linda and Ava made one fewer erasure in completing the matrices, Janet's erasures increased dramatically (from 2 to 36). She appeared to have initially missequenced her final 36 responses on the answer sheet; she then erased and reorganized those responses.

Further quantifiable documentation of erasures in multiple contexts is required; however, at this time it would appear that two of the I.E. students (Linda and Janet) were using strategies which resulted in fewer erasures in

the context of I.E. class but were not displaying similar reductions in erasures in a test situation. This would suggest the two students had not generalized their newly acquired behaviors to performance on the Standard Progressive Matrices.

Second, a lengthened time between input of the question and actual output of the answer was observed in the daily responses of Janet and Linda and reported by the teacher. Similar verbal reports were made by the speech/language pathologist with respect to June testing responses. For example, in September, the students responded almost immediately both to oral and written questions; there seemed to be little reflection on the nature of the problem and how it could best be solved prior to making a response or requesting help from the teacher (eg. Linda: I don't get it. What do I do here?). By January, Janet and Linda were frequently observed to read from their assignment and then begin an activity which at first seemed to be daydreaming. When interrupted by the teacher asking if help was required, the students would reply that they didn't need help; they were just thinking. After the teacher's interruption the students would resume their thinking poses for a few moments longer then nod in understanding, and finally begin to write their answers. These students had introduced what appeared to be a noticable but unquantified delay between the input and output phases of thought.

Three of the four I.E. students (Janet, Linda, and Sandra) seemed to become increasingly aware, and finally to make explicit their awareness, that producing a good quality oral response also required time to think. Early in the year, all four I.E. students had adopted the I.E. motto "Just a minute ... Let me think" which was associated with the program. It was used as a strategy for restraining impulsivity and as a reminder to think before responding.

In January, the phrase took on a new shade of meaning. One of the I.E. students (Janet) had become very dominant in the I.E. class discussions and inadvertently responded to more than her share of questions by breaking in as the other students paused to think. Linda therefore began to use the motto to fill in the lag time between the question input and response output to deter other students from interrupting.

Sandra appeared to demonstrate evidence not only of internalizing this verbal planning function for herself, but also of helping non-I.E. classmates to do the same. This mediation of other students occurred most commonly with respect to restraint of impulsivity. For example, on April 13, Sandra shared her awareness of this strategy with Denise, a pupil from another class. As Denise answered impulsively during tutorial work involving she and Sandra, Sandra advised her "You talk too fast. Think before you talk. Don't say right away".

Responses and behaviors of these three I.E. students (Janet, Linda, and Sandra) during the April and June reading

closure task appeared to be supportive of the anecdotal data with respect to delayed response. In the September reading closure activity the students were asked how they planned to do the task; two students (Linda and Ed) said they could not know their strategy yet because they had not yet started the task. The notion of planning a strategy seemed literally impossible to them, as was thinking about thinking. The following excerpts are taken from Appendix G and H containing a sample I.E. student's strategy (Sandra's) and a sample regular program student's statement of strategy (Annette's); the excerpts demonstrate the students' limited facility in planning or explaining their strategies.

> Sandra: (Sept)
> My strategy is to look at the words what they have there and there are some blanks before and after it. Think of a word what is good and it make sense for the sentence.

> Annette : (Sept)
> To find a clue from a word. Then I read the sentence over to find out if the word fit into it. Then I read the whole thing over to see if everything was correct.

Consistent with the excerpts, in September, none of the I.E. or regular program students were interested in overviewing the task to select an appropriate entry point or strategy. By June, each of the four I.E. students (Linda, Janet, Ava, and Sandra) verbalized and employed the strategy of reading the entire passage to be closed as well as elaborated their reasons for doing so. The following excerpt from Sandra's June strategy, shown in Appendix G, provides a good example of this elaboration of strategy:

Sandra: (June)
First, I just take a look what it's about because I want to know what it's about ... So I found out now and I don't know what to say at the top, the first sentences or more, so I just start from the bottom.

Two of the regular program students (Donna and Ed) also verbalized the strategy of prereading the task for main idea, but did not actually employ it. It would appear that in prereading the reading closure tasks, Janet, Linda, and Sandra were demonstrating a new strategy which was consistent with their I.E. training, as well as, with anecdotal observations regarding planning and restraint of impulsivity. It was also a behavior which was unique to the I.E. students.

Changes in the entry points chosen by Linda and Sandra in the June reading closure task also appeared to be unique and reflective of new planning behaviors. In September, all I.E. and regular program students chose the first sentence of the passage as their entry point. By June, however, three of the I.E. subjects (Janet, Linda, and Sandra), decided to start from the end and work forward. They selected their entry point based on ease of entry, rather than sequence, as illustrated in the following excerpts from Linda's and Sandra's statements of strategy:

Linda:
First thing, I read the whole thing and see which one I can get some words.

Sandra:
And if you don't understand the beginning, just look in the one that's easy. So you start the easiest and go to the hardest.

This would appear to indicate a change in strategy which the regular program students did not display and which may be reflective of increased planning behaviors reported anecdotally.

While anecdotal observations and reading closure interviews were supportive of at least some positive change in three individual I.E. students, use of time data from the Standard Progressive Matrices were more ambiguous. As shown in Table 3, two of the I.E. students (Ava and Janet), showed two or three point increases in individual scores on this test which were accompanied by an increase of seven minutes and 19 minutes respectively in the time invested to complete the task.

TABLE 3

Performances on Standard Progressive Matrices Reported in Raw Score Out of Possible 60 and Minutes of Elapsed Time For Completion.

	Raw Score			Time		
I.E. Program	Sept	June	Net Change	Sept	June	Net Change
Linda	45	41	-4	38	31	-7
Janet	43	46	+3	31	50	+19
Sandra	46	46	+0	27	30	+3
Ava	46	48	+2	20	27	+7
Regular Program						
Annette	43	41	-2	35	30	-5
Donna	37	32	-5	50	55	+5
Ed	50	50	+0	25	30	+5

It should be noted that Janet also made an error in sequencing on the test so it is ambiguous as to whether the increase in time is due to checking or to correcting her sequencing error involving 36 items. It is, however, interesting to note that the checking behavior Janet displayed in June was not seen in September and therefore it would appear to be a new behavior.

It is interesting to observe, from Table 3, that Sandra's high score and approximate use of time remained the same; this lack of change seems to be consistent with September anecdotal observations of her already developed success in restraining impulsivity. In contrast to Janet's performance on the Standard Progressive Matrices, the last member of the I.E. group showed an unexpected decline in score and decrease in time. In fact, Linda, a rather moody student, worked more impulsively on the post test than she did on the pre test. Clearly some students appear to have been more greatly influenced than others; these results provide a good example of the differential effect of the program. The degree of behavioral change in the students seems to be dependent on the material being processed and the context within which it is handled.

In summary, with respect to use of time, it would appear that Janet, Linda, and Sandra may have been influenced to a higher degree than Ava based on anecdotal observations and reading closure data. Reflection of similar strategies in the completion of the Standard Progressive Matrices is both limited and ambiguous. Further research which examines and quantifies student response times in a variety of contexts and modalities would seem to be required as a means of further examining changes in the impulsivity of I.E. students and the generalizability of those changes.

Third, anecdotal evidence suggested that each of the four individual I.E. students began to demonstrate interest

in approaching tasks in a more systematic way. For example, in response to a comparative essay assignment in English, Ava demonstrated her acquisition of systematic work by developing a chart of similarities and differences from which she drafted her composition. Similarly, in completing the Magic Cube puzzle, Janet developed her solution in tabular form rather than by cube manipulation. It would seem that the two I.E. students may have generalized the concept of systematic comparison (and its related strategies) from I.E. class to these new situations.

Linda and Ava appeared to demonstrate increasing awareness of the importance of systematic work and began to share their awareness with the regular program students. On April 9, for example, the school principal was invited as a class guest for the purpose of being interviewed by the students. In the interview the students were permitted to refer to a set of questions they had already prepared. During the mock interview the I.E. students (Linda and Ava) carefully checked off those questions already asked so as to avoid duplication. This strategy had been recently used in the I.E. class and now seemed to have generalized to this context. The regular program students, also in the same class, did not demonstrate this type of behavior. One regular program student (Ed) frequently repeated the questions of others. When Ed and other non-I.E. members of the class repeated questions already asked, Linda and Ava discretely suggested they check off the questions or work

systematically down the list to avoid the duplication.

Some reflection of the anecdotal observation that individual I.E. students had become less impulsive and more interested in systematic work was observed in the results of the Word Associations subtest of the CELF which required the subjects to generate as many members as possible of the two classes given (foods and animals). In September, all of the I.E. and regular program subjects responded by randomly listing members of a variety of subcategories without systematically exploiting any of the subcategories before beginning the next. With the exception of pairs of associations, category members were not organized according to any plan or system.

In June however, all four of the I.E. subjects demonstrated a qualitative change in their strategy for completing the two Word Associations tasks which is exemplified by Janet's June test results. In June, Janet's strategy for generating a list of animals had changed very dramatically. She systematically chose and exploited the following animal subcategories employing chains of three to five members:

1. birds - five members of chain, (crane, parrot, owl, eagle, robin)
2. cat family - three members of chain, (lion, tiger, leopard)
3. bovine family - three members of chain, (ox, camel, cow)
4. ape family - three members of chain, (monkey, ape, gorilla)

The change observed in Janet's performance on this subtest is very consistent with that of other I.E. students. In contrast, the three regular program students did not demonstrate the use of planned or systematic work in recalling the names of as many animals as they could.

As shown in Table 4, in three of the four I.E. subjects (Ava, Sandra, and Linda), this change of strategy on the Word Associations Subtest was accompanied by quantitative change of two or more grade equivalents but not approaching one standard deviation (10.6 points).

TABLE 4

Performances by I.E. and Regular Program Students on the Word Associations Subtest of the Clinical Evaluation of Language Functions

	Raw Scores			Grade Equivalents		
I.E. Program	Sept	June	Change	Sept	June	Change
Linda	28	35	+7	7-8	10-12	+3.5
Janet	25	25	+0	5	5	+0
Sandra	22	26	+4	3	5	+2
Ava	28	33	+5	7-8	10-12	+3.5
Regular Program						
Annette	29	30	+1	7-8	9	+1.5
Donna	12	16	+4	K	1	+1
Ed	34	43	+9	10-12	10-12	+0

This task may have been affected by the development of self regulatory behaviors such as planning and systematic work. It is interesting to note that none of the regular program subjects demonstrated similar qualitative or quantitative change on this measure.

In light of two potential areas of criticism of the CELF test, these quantitative changes must be examined with caution. The test's narrow range of raw score differences as in Sandra's performance can translate into what would seem to be "significant" grade equivalent differences. In addition, there are large inconsistencies in the number of raw score points which translate into grade score changes across age levels as observed in Sandra's and Donna's scores. These two factors make the true significance of the observed score changes uncertain. It is, however, interesting to observe the parallel between the qualitative and quantitative changes shown by three of the I.E. students and is worthy of further investigation.

In summary, quite consistently, three of the I.E. subjects appeared to demonstrate gains in self regulatory behaviors related to planning and restraint of impulsivity which, in September, had been especially weak. Several behaviors within this category were noted. Hypothesis testing strategies as well as strategies to increase the lag time between the input of a problem and the output of its response lead to fewer erasures within the context of I.E. class. In addition, planning a systematic problem solving strategy which included selection of entry point prior to solving a problem helped the I.E. students to avoid omitting or duplicating parts of the task. Changes appeared to be highly individualized and changes noted anecdotally were not necessarily carried over into testing situations.

B. Student Responsibility for Learning

In September anecdotal observations made by the teacher of the hearing impaired and the speech/language pathologist revealed that six of the seven students (Janet, Linda and Ava from the I.E. program, and the three regular program students) appeared to be similar with respect to the passivity they displayed in the learning process. Sandra, the remaining I.E. student did not demonstrate the passive behaviors which follow. According to the observers, the passivity observed in the six students seemed to be displayed in the form of two opposite extremes of dependent behaviors; they displayed either excessive dependence on the teacher for assistance or excessive dependence on self.

Rather than attempting to think the task through for themselves, in September two of the I.E. students, (Janet and Linda), and one regular program student (Ed) made multiple unnecessary requests each day in English class for additional explanation. In contrast, one of the I.E. students (Ava) and two regular program students (Annette and Donna) would begin to work without obtaining the necessary instructions and thereby did not really know what to do. Both extremes of behavior seemed to reflect a passive approach to learning.

Two of the I.E. students (Ava and Sandra) and each of the three regular program students (Annette, Donna, Ed), also seemed to be passive with respect to their participation in class discussion. Though discussion

participation was not actually sampled and quantified in this reseach, it was reported by the teacher that in a typical 20 minute class discussion, the five students may not volunteer a single response or opinion. It was necessary for the teacher to actively pursue these students' contributions through questioning.

In September anecdotal notes revealed that the I.E. and regular program students appeared to limit their questions of the teacher, or of other students, to those of an information seeking nature which required a single correct answer. (eg. How do you spell ...? What day is today? What's the character's name? etc...). Though further research which examines and quantifies the nature of student questions would be valuable, based on the reported behaviors it is hypothesized that the students may have felt it was the responsibility of the teacher to transmit information to them as they passively waited for it to be given rather than actively searching it out for themselves by consulting reference materials.

Work habits of three of the I.E. students (Janet, Linda, and Ava) as well as each of the three regular program students (Annette, Donna, and Ed) also seemed to reflect a passive attitude toward learning. Responsibility for reading and clarifying instructions was therefore assumed by the teacher rather than the students. In September, the teacher assumed the "active" role for learning while the students' roles appeared to be largely passive.

Beginning in November and emerging slowly across the year, the four individual I.E. students displayed behaviors which would suggest that they were beginning to perceive their role in the learning process as requiring a more active part. The following four types of behavior were observed to varying degrees in individual I.E. students:

1. Using reference materials and asking essential questions
2. Generalizing I.E. strategies which promoted independence in vocational settings
3. Generating one's own reference material through notetaking
4. Using the teacher as an information "confirmer" rather than as an information "giver"

First in November, two of the I.E. students (Linda and Janet) began to use reference materials and appeared to differentiate between essential and non-essential questions rather than relying on the teacher to provide the information required. For example, though Linda still asked "How do you spell ...?", she would catch herself and say "Never mind, I can look it up." This example was typical of Janet as well, who like Linda had frequently asked unnecessary questions. This emerging differentiation of essential and non-essential questions was not, however, typical of Ed, a regular program student who continued to expect the teacher to provide him with information such as word spellings and instructions.

At approximately the same time, Ava, one of the I.E. students who had previously been excessively independent, began to make inquiries about her work, such as "I don't understand this", "Am I supposed to...?". For approximately a month Ava seemed to become dependent on the teacher; she asked questions which she could have easily answered herself by re-examining the task. After the "transition" period, however, Ava appeared to begin to more successfully balance the two forms of dependence and take a more active role in her own learning by asking for clarification when it was truly required.

Based on anecdotal reports, the regular program students (Donna, Ed, and Annette), who had initially displayed similar unquestioning roles, did not appear to show a perceptible change with respect to their ability to discriminate between problems which they could solve independently and those which they could not; they did not begin to ask clarifying questions. Further research which examines and quantifies student use of questions as one parameter of active/passive learning habits is warranted.

Second, behavioral reflections of change in Janet's and Ava's (two of the I.E. students) roles in the learning process appeared to show generalizaton to their vocational work at the end of January. For example, in October, Janet's vocational teacher reported that Janet was asking a number of unnecessary information seeking questions whereas in February the same teacher observed that Janet seemed to be

making an increased effort to look up the information required in the dictionary or textbook and to think through her own solutions to problems. Similar reports regarding the use of reference materials were made by Ava's vocational teacher. Further research involving the use of classroom checklists focusing on "microchanges" in behavior may be helpful in documenting generalization of behaviors to other classes.

Third, potential evidence of the four I.E. students taking a more active involvement in the learning process was observed in student notetaking skills as a means of generating one's own reference material. For example, whereas in November and December Linda's doodling on the I.E. folders and pages had been a problem, by January, a noticeable reduction in doodling had occurred. It was replaced by copious notetaking of everything the teacher wrote on the overhead during I.E. class. Each of the four I.E. students had begun notetaking during I.E. class; no teacher direction had been given. It is suspected that the students became aware that by recording these notes they were providing themselves with cues upon which they could draw when asked to summarize what was learned that day.

It should be noted, however, that no observable change in notetaking behavior in English class was reported. It is possible that because the teacher's use of the overhead was less extensive in English class, limited modelling of notetaking behavior, as well as more limited opportunity for

spontaneous notetaking, was provided. In addition, a student generated summary of each lesson was not an integral part of each English class as it had been in the I.E. class; therefore, the need for such cues may also have been reduced. Future research which examines more closely notetaking behavior as one way in which students may become more active in the learning process as a result of participating in I.E. would be of interest.

Fourth, three of the I.E. students (Janet, Linda, and Sandra) appeared to begin to employ the teacher as an information "confirmer" rather than an information "giver". This role was particularly evident in verifying spelling. The students spelled the word to the teacher simply to doublecheck. (eg. Linda: Did I spell "behave" right? Is "explain" E-X-P-L-A-I-N?). The same three students, as well as Ava, also began to spontaneously consult the dictionary, calendar, table of contents and blackboard notes prior to asking for information.

Ava seemed to become aware of, and to verbalize, this shift in student behavior. On February 27, when two of the non-I.E. students in class (Ed, Brad) asked the teacher about how to spell a word, as they frequently did, Ava remarked quietly, "They (Brad and Ed) always ask how to spell words". This shift in the student-teacher relationship was observed in each of the four I.E. students though to varying degrees, with Janet and Linda influenced to a greater degree than Ava and Sandra.

Unlike the I.E. students, the regular program students did not appear to facilitate change in the role of the teacher to one of confirming that which is already known. Their behaviors made it difficult for the teacher to change her September role of "information giving" and to assume less responsibility for the learning process.

The Student's Perception of Ability Scale (SPAS) had been administered to see if behavioral and strategic changes would be reflected in more positive feelings about academic success; results did not show this. As shown in Figures 1 and 2 clearly, no patterning of scores seemed to emerge among I.E. students which differentiated them from regular program students. Two of the I.E. students (Janet and Sandra) as well as one regular program student (Ed) showed similar increases and decreases in their scores which did not approach one standard deviation. Increases in score, of the magnitude of one standard deviation, were apparent in only two instances: the April score of one I.E. student (Linda), and, the June score of one regular program student (Annette). In light of the personalities of these two students the implications of their score changes must be viewed with some skepticism.

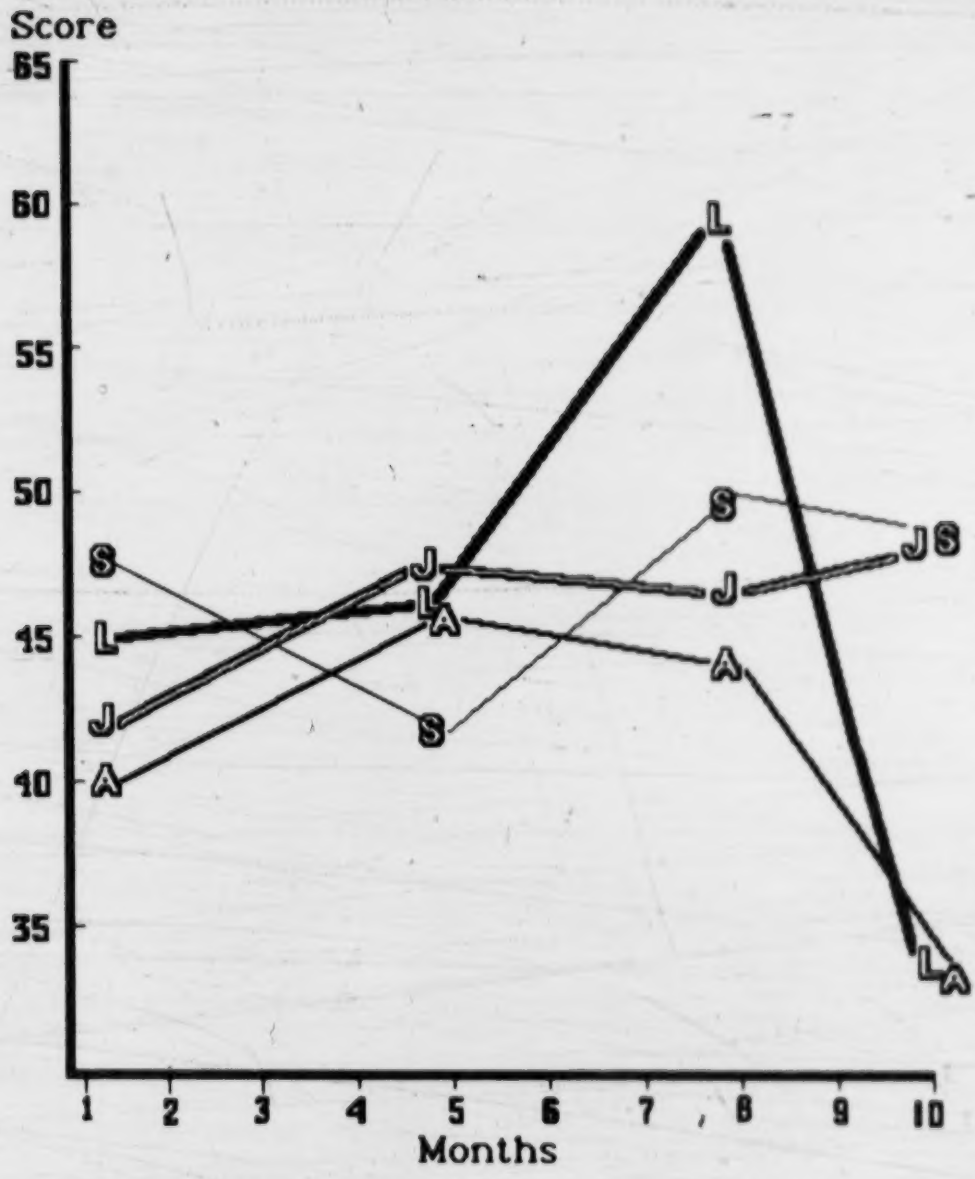

Figure 1

Performances By I.E. Students Linda(L), Janet(J), Sandra(S), and Ava(A) on the Student's Perception of Ability Scale Reported in Raw Score Out of Possible 70

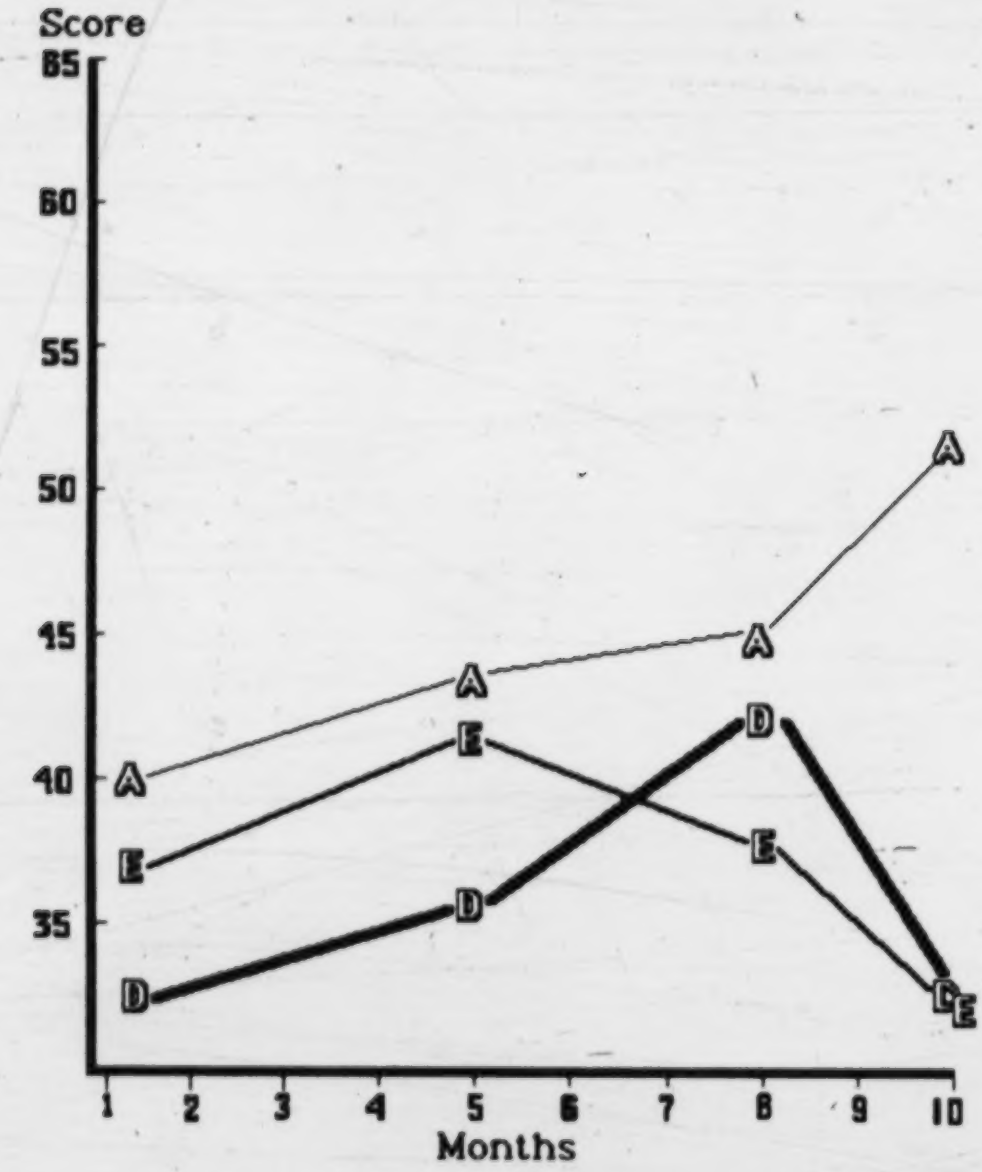

Figure 2

Performances by Regular Program Students Annette(A), Donna(D) and Ed(E) on the Student's Perception of Ability Scale Reported in Raw Score out of Possible 70

A decrease in the scores of two of the I.E. students (Linda and Ava), and one regular program student (Ed), was observed on the final test period. In the two I.E. students, this decrease approximated one standard deviation. However, the remaining two I.E. students (Sandra and Janet) and two regular program students (Donna and Annette) did not evidence this drop. The decrease in June test scores may potentially be explained by differences in stress contributed by final exams and course loads. Though it was intended that all assessment for this research be completed by mid June so as not to be unduly influenced by final exams and the stress they may induce, unforseen circumstances occurred. The school exam schedule was not rigidly adhered to and several exams were unexpectedly administered prior to exam week thus potentially influencing this test.

Although behaviors were reported anecdotally which suggested that I.E. students were assuming a more active role in the learning process, there did not appear to be any indication on the SPAS of more positive feelings about academic achievement which one might expect in accompaniment of such a change in student roles. Based on these results, it would appear that academic self concept, as measured by the SPAS, was not a parameter in which even individual students participating in I.E. showed any solid evidence of change. Because of the varying patterns, it is interesting to note the possible effects of outside influences on the students' fluctuating perceptions of themselves.

In summary, across the year, a number of potential indicators of change were observed in the four individual I.E. students with respect to student roles in the learning process. To varying degrees, the students appeared to learn strategies such as consulting reference materials and differentiating between essential and non-essential questions across which to balance excessive dependence on the teacher and excessive dependence on themselves. Further research which attempts to sample and quantify behaviors in this area would be valuable. The development of an interview or questionnaire instrument which specifically examines how students perceive their role in the learning process may be helpful in documenting this phenomenon; the Student's Perception of Ability Scale was not helpful in this regard.

C. Generalization of Behaviors and Concepts

In September, it was observed by the teacher that the four I.E. students and the three regular program students seemed to experience difficulty in spontaneously generalizing behaviors and concepts from one situation to another. The extent to which their knowledge had been compartmentalized, particularly in Janet and Ava, seemed to be well symbolized by their binders neatly labeled so that one field of knowledge did not touch the next. The knowledge was carefully separated by stiff cardboard dividers defining the bounds of generalizability. Though the dividers eased the task of filing, they unfortunately also seemed to serve as reminders to the students to keep their subjects separate.

Janet, for example, appeared to take these cardboard reminders very seriously. In September, when Janet was receiving some tutorial help in math to understand the use of exponents, she was asked to recall the metric notation she had just learned in science for measuring area and volume (square centimeters, cubic centimeters). Her response was "That's different. That's science". It did not seem possible to her that the concept could be, or should be generalized. This unwillingness to compare, coupled with what may have been limited expertise in selecting relevant features through which to generalize, seemed to be most characteristic of three of the I.E. students (Janet, Linda, Ava) and two of the regular program students (Donna and

Annette).

Across the year three potential areas of change with respect to generalization were observed among individual I.E. students:

1. Increased attention to relevant cues
2. Increased spontaneity of generalizations
3. Increased abstraction of generalizations

First, in September, none of the four I.E. students were able to generate their own examples (or bridges) of the I.E. principle under study. However by the middle of October, three of the students (Linda, Janet, and Sandra) were, with careful mediation, able to respond "yes" or "no" in a step by step analysis of the relevant cues determining the appropriateness of a teacher provided bridge.

It was not until November that these three I.E. students seemed to understand the concept of bridging (or applying I.E. principles and strategies to new contexts) and attempted their own examples. This form of generalization occurred only in very structured teacher directed tasks within the context of I.E. class. The students required several sample bridges each lesson to use as models for their own bridges before rigidly copying one of the teacher models. For example, on November 22, the I.E. class was discussing the value of short cuts. After sample bridges were provided by the teacher related to short cuts in cooking, transportation short cuts and short cuts in doing homework, Janet, Linda, and Sandra each provided bridges

whereby they had turned up the temperature of the oven higher than called for by their recipes to short cut the required cooking time. In each case the bridge was a rigid reconstruction which cautiously imitated the teacher example.

While three of the four I.E. students seemed to make progress in acquiring the concept of bridging, even at the stage of analyzing the cues of the teacher bridge, the fourth I.E. student (Ava) appeared to have much more difficulty with the concept. This difficulty persisted all year and Ava was the least successful of the four I.E. students in identifying relevant cues and bridging to new situations. This was apparent from Ava's difficulty in thinking of an appropriate bridge; often when she could think of an example it did not fit the principle because it was based on irrelevant cues.

It is interesting to note what appears to be recurring evidence of the differential effect of the program on individual students. Valuable information would be provided to educators by research which contributes to explaining why some students are little influenced by the program and under what conditions the influence can be maximized for hearing impaired students such as Ava.

Second, as the year progressed ability to compare seemed to become increasingly more automatic in three of the I.E. students (Janet, Linda, and Sandra) thus permitting them to bridge more spontaneously. At first, their own

bridges were not well focused nor always appropriate, but clearly, the three students were spontaneously attempting to unite, by way of a conceptual bridge, two islands of information from differing contexts. An incident of November 9 clearly demonstrated this type of attempt. The I.E. class was just beginning to study a new concept - hypothetical thinking; they were asked if anyone knew what it was. Earlier in the year everyone would have simply shrugged their shoulders, but Sandra responded after a moment that she thought it meant "too much thinking". "No", she corrected, "that's hyper-". She had confused the prefixes hyper- and hypo- which she had been studying in Beauty Culture class and mistakenly, but spontaneously, bridged that knowledge to this situation.

At least some reflection of the anecdotally reported development of comparative behavior was obtained from the Word Classes subtest of the CELF shown in Table 5 in which the students were required to identify which two of the words in the set given were most closely related.

TABLE 5

Performances by I.E. and Regular Program Students on the Word Classes Subtest of the Clinical Evaluation of Language Functions

	Raw Scores			Grade Equivalents		
I.E. Program	Sept	June	Change	Sept	June	Change
Linda	31	33	+2	3	5	+2
Janet	28	34	+6	3	5	+2
Sandra	35	37	+2	6-8	10-12	+4
Ava	21	32	+11	1	4	+3
Regular Program						
Annette	40	43	+3	10-12	10-12	+0
Donna	20	27	+7	1	2	+1
Ed	31	34	+3	3	5	+2

As shown in Table 5, the four I.E. subjects, without exception, improved by two or more grade equivalents on this subtest, although as discussed earlier, potential areas of criticism of the CELF test would warrant caution in examining the grade equivalent changes in the scores of

Linda and Sandra. The differences, however, observed in Janet's and Ava's pre and post test scores approximate one standard deviation (8.8 raw score points).

It is interesting to note that the nature of the improvement shown by the four I.E. students consistently involved items related by semantic class or verbal opposite. It is possible that their improved performance may be better explained not by increased receptive vocabulary but by their participation in Instrumental Enrichment programming through which instruction and experience was provided in cognitive functions such as the selection of relevant cues, spontaneous comparative behavior, and dealing with multiple sources of information.

It should also be noted that on the Word Classes subtest, unquantified delays in response times as well as the spontaneous use of rehearsal strategies were observed in two I.E. students (Linda and Sandra) and reported by the speech/language pathologist. Thus, these behaviors may lend support to the explanation favoring strategy development rather than vocabulary development. However, as shown in Table 5, one of the regular program subjects (Ed) also demonstrated improvement on this subtest, cautiously translating to two grade equivalents but clearly less than one standard deviation of change; a similar pattern of improvement in items of semantic class and verbal opposites was observed in his performance though none of the three regular program subjects demonstrated changes in strategy.

From the results of the Word Classes subtest, it would appear that at least two of the I.E. students (Janet and Ava) may have shown meaningful change though each of the four I.E. students have demonstrated score changes cautiously translating to increases of two or more grade equivalents. In addition, all four I.E. subjects have shown patterned improvement in specific types of items. It is not clear, however, whether these findings are supportive of the anecdotally reported changes in light of Ed's improvement on similar items and Ava's consistent weakness in bridging. Further research in this area, however, would appear to hold potential.

Development of comparative behavior in individual students may also have been be reflected in the results of the Relationships and Ambiguities subtest of the CELF shown in Table 6.

TABLE 6

Performances by I.E. and Regular Program Students on the Relationships and Ambiguities Subtest of the Clinical Evaluation of Language Functions

	Raw Scores			Grade Equivalents		
I.E. Program	Sept	June	Change	Sept	June	Change
Linda	42	42	+0	4	4	0
Janet	44	47	+3	4	6-8	+3
Sandra	45	53	+8	5	10-12	+6
Ava	40	42	+2	3	4	+1
Regular Program						
Annette	56	57	+1	10-12	10-12	+0
Donna	46	47	+1	5	6-8	+2
Ed	49	52	+3	10-12	10-12	+0

The subtest required the students to analyse the relationship given in the stimulus sentence and to respond "yes/no" as to whether the second stimulus accurately recaptured the relationship given in the first stimulus. As shown in Table 6, in June, two of the four I.E. subjects (Janet and Sandra) demonstrated score changes on this

subtest translating to three and six grade equivalents respectively. Though Janet's raw score change must be examined cautiously with respect to the influence of standard error (3.3 points), Sandra's raw score change approaches one standard deviation (or 10.9 points) on this test. That Sandra and Janet demonstrated score changes of multiple grade equivalents seems to be consistent with bridging or comparative behavior reported anecdotally. It is somewhat unexpected, however, that Linda, who demonstrated similar bridging skills, did not also demonstrate a similar score change on this subtest. This conflict of anecdotal and test data seen again in Linda is potentially explained by factors within her personality, which were discussed earlier, and the differential effect of the program.

As shown in Table 6, though one regular program student (Donna) also demonstrated a score change equivalent to two grade equivalents, it should be considered in light of the subtest's standard error of measurement. In addition, it should be emphasized that the two I.E. students' score changes clearly involved improvement on items of comparative, temporal, familial, and analogous relationships whereas the regular program student improved most in processing spatial relationships. It would appear that the qualitative change underlying Donna's performance may not be the same as that which underlies the performances of Janet and Sandra.

It is interesting to note that, as in the improvement shown in specific items on the Word Classes subtest, the change within the above mentioned categories of items may also be related to an improvement in ability to project relationships, to spontaneously compare, and to select relevant cues by which to make the comparison.

In summary, comparative behavior is a function which is central to the year one I.E. program as it is a foundation for more sophisticated operations such as classification, seriation, and syllogistic thinking (Pace 1983). As a result, a portion of each lesson is devoted to making comparisons so that spontaneous comparative behavior will become automatic. Three of the I.E. students (Janet, Linda, and Sandra) had become much more effective in comparing two situations and generalizing between them through the bridging phases of I.E. lessons. These experiences may have assisted Janet and Sandra in their performances on this subtest. Transfer of comparative behavior skills to the subtest items involving the processing of metaphors, idioms, or proverbs did not seem to occur; this may have been due to the complications of language structure and lack of experience.

Third, as time progressed, three of the I.E. students (Janet, Linda, and Sandra) bridged more spontaneously and along more abstract parameters in the sense that their bridges were no longer cautious imitations of the teacher's models. Most commonly in I.E. class the three students

generated bridges into their vocations (Linda into Commercial Art, Janet into Business Education, and Sandra into Beauty Culture) or into their own daily life routines such as transportation, household responsibilities, and homework. The most abstract bridge was produced by Janet in May. After the I.E. group had discussed examples of subordinate and superordinate concepts, Janet remarked, "That's (superordinate concepts) almost like inductive thinking." She had bridged between superordinate concepts and inductive thinking because in both instances information would be of a general nature. In contrast, subordinate and deductive thinking would be related by the specificity of content. The parameter across which she had generalized was highly abstract and was atypical of the generally moderate level of abstraction shown in the student bridges into the academic, vocational, and daily life areas which was better characterized by the following example. In discussing the strategy of eliminating alternatives to narrow choices, Sandra exclaimed, "I can do it on Wednesday when I do my multiple choices" (a multiple choice English exam). Clearly, student bridges had increased in their level of abstraction as compared with the imitative quality of the October and November examples discussed earlier.

The Canadian Tests of Basic Skills - Mathematics Problem Solving subtest was administered for the purpose of examining whether the strategies and behaviors anticipated to develop in I.E. students would be generalized to a new

field of content. Test results shown in Table 7 did not provide support for the generalizing behaviors observed in Janet, Linda, and Sandra.

TABLE 7

Performances on Canadian Tests of Basic Skills - Mathematics Problem Solving Subtest

	Raw Scores			Grade Equivalents		
I.E. Program	Sept	June	Change	Sept	June	Change
Linda	11	9	-2	4.6	4.3	-0.3
Janet	15	18	+3	5.3	5.7	+0.4
Sandra	19	17	-2	5.9	5.5	-0.4
Ava	13	11	-2	5.0	4.7	-0.3
Regular Program						
Annette	16	15	-1	5.5	5.3	-0.2
Donna	7	6	-1	3.6	3.5	-0.1
Ed	19	17	-2	5.9	5.5	-0.4

As shown in Table 7, it would appear that based on the June score on this test of three of the I.E. students (Linda, Sandra, and Ava) and the three regular program

students no real differentiation from September had occurred. In fact, with the exception of one student (Janet) all I.E. and regular program students showed score decreases. It would seem that generalization had not occurred even though success on the test would appear to involve many of the same strategies discussed in I.E. class. It is not clear, however, whether Linda and Sandra possessed appropriate strategies which they did not generalize to the CTBS test, or, if the strategies they required to effect a change in performance had not been taught in the level I program. One I.E. student (Janet) did however, show an improvement of three raw score points (15 to 18), which when cautiously examined within the context of her improvement on other instruments, may warrant further study of the potential relationship between Instrumental Enrichment programming and success in math problem solving.

In summary, three of the I.E. students appeared to demonstrate potential areas of change in self regulatory behaviors with respect to generalizing. Initially, both the I.E. and regular program students seemed reluctant to spontaneously generalize. From their behaviors it appeared that they lacked the tools of comparison. Across time, three of the four I.E. students seemed to become aware, through overt teaching, that spontaneous generalization was expected of them; a portion of each I.E. class had been devoted to this end. The regular program students did not receive this training or encouragement. Bridging skills progressed in the

three I.E. students from rigidly manufactured structures between concrete and proximal islands of knowledge to more spontaneously generated conceptual spans uniting more distal and abstract information. The fourth I.E. student also improved with respect to her expertise in bridging but she remained noticeably weak in this area as compared with the other I.E. students. Her bridges remained rigidly manufactured or based on irrelevant cues.

D. Demand For Precision in Self and Others

In September, anecdotal observations made by the teacher and speech/language pathologist indicated that three of the Instrumental Enrichment subjects (Linda, Janet, and Ava) and two of the regular program subjects (Donna and Ed) seemed to be similar with respect to their reduced need for precision in themselves; there was little evidence of self checking in their work or demand for linguistic precision. For example, written responses of the five students were seldom complete and often irrelevant to the topic. Orally, failure on the part of the students as speakers to make their message explicit to their listener made communication particularly difficult with Janet, Ava, and Ed. It was necessary for the listener to ask questions such as "Who do you mean - she?" to identify the referent for indefinite or personal pronouns which had been used. Though not specifically sampled and quantified, it was noted that, with the exception of "here" and "there", spatial referents seemed to be seldom employed by the five students; therefore, giving, as well as processing, precise directions was difficult. For example, in September, Ava was looking for the stapler which Janet had just been using. When asked

where she put it, the following events transpired:

> Janet: It's over there.
> Ava: Where?
> Janet: In the desk.
> Ava: Can't find it.
> Janet: Look the drawer.
> Ava: (opening and closing desk drawers).
>
> (Janet finally got up and got the stapler for Ava rather than trying to explain which drawer it was in).

It is interesting to note that the remaining two students (Sandra and Annette) did not appear to display comparable linguistic imprecision in their oral and written work. This is perhaps explained by their more advanced language skills.

Across the year, two potential areas of change, related to an increase in the demand for precision in oneself and in others, were seen in individual I.E. students. Changes in precision occurred in several areas but appeared to be most marked with respect to linguistic precision. This precision took two forms:

1. More refined usage of familiar as well as newly acquired vocabulary
2. Greater elaboration of sequence and detail

First, classroom observations, made in the context of English class and speech/language sessions, suggested that three individual students (Janet, Linda, and Ava) were beginning to use I.E. vocabulary items related to the concept of precision to discuss the issue of precision in communication. For example, on November 24, it was first

observed that Ava had begun using an I.E. vocabulary item ("referent") spontaneously and was concerned about linguistic precision. Her English class had been reading an article about the Loch Ness Monster; when the teacher, like the author of the article, refered to the Loch Ness Monster as "she", Ava said "Why she? No referent". She was questioning the author's precision in the use of the pronoun "she".

Although it has been noted that Ava was consistently weaker than the other three I.E. students with respect to her success in bridging and generalizing, it is interesting that her anecdotal records provide good examples, such as the one above, of an increased need for linguistic precision. This would seem to reinforce the observation made earlier that the program appears to have differential effects on students not only with respect to the material being processed and the situation, but also with respect to the nature of the students' efficient and deficient functions.

Each of the four I.E. students, but particularly Janet, were beginning to use the terms "referent", "impulsive", "precise", and "strategy" outside of I.E. class during speech/language sessions as well as in English class. On February 7, for example, the speech/language pathologist reported that after Janet made an error Janet said that she had been impulsive and that had caused the error in the work they had been doing. Janet concluded the exchange by saying

"That was impulsive. I like that word". The vocabulary item "impulsive" must have been an especially meaningful concept for Janet as it seemed to be one of her most frequently used I.E. concepts in spontanous language.

Increased demand for linguistic precision in self did not appear to be restricted to the use of I.E. vocabulary which had been newly acquired. Two I.E. students (Ava and Janet) appeared to become increasingly precise in their use of familiar words to denote space. Rather than simply pointing or using the adverbs "here" and "there", more precise spatial vocabulary began to evolve as early as December. For example, on April 4 the English class was continuing to read a short story which was begun on the previous day; they were told to turn to the top of page 12. "Right or left column?" Janet and Ava demanded simultaneously. Later in the same class, Ava wanted to know how to pronounce a word recorded on the overhead, "How do you say that word up on the top on the right?" she asked. Earlier in the year she would simply have said, "How do you say that word?". Examples of the use of spatial referents were not common in September but across the year developed slowly in Ava and Janet and appeared to contribute to their increased precision in producing and processing directions. Further research which samples and quantifies this aspect of student language as they participate in class may be interesting.

It had been expected that language samples may also have reflected similar interests in precision. In Lee's Developmental Sentence Scoring (D.S.S.) analysis, the more imprecise indefinite pronouns and noun modifiers (eg. "this", "that") are given a score of 1; more precise modifiers (eg. "all", "more", "one", "none", "five", "many") are given 3-6 points of a possible 8. The higher scores are awarded for more precise and later developing modifiers. The D.S.S. procedure averages across the total number of sentences in the student's sample to produce a total D.S.S. which reflects the combined grammatical load of the eight categories scored per "average" sentence. As shown in Table 8, the D.S.S. analysis itself did not appear to reveal any meaningful changes defined as one standard deviation (1.6 D.S.S).

TABLE 8

Results of the Lee Analysis Performed on Spontaneous Language Samples Reported in Total Developmental Sentence Score

	D.S.S. Score			Lang. Age Estimate		
I.E. Program	Sept	June	Change	Sept	June	Change
Linda	7.40	8.60	+1.2	4-0	5-0	+1yr
Janet	7.70	7.60	-0.1	4-4	4-4	+0
Sandra	8.10	7.80	-0.3	4-6	4-4	-2mo
Ava	7.40	6.50	-0.9	4-0	3-6	-4mo
Regular Program						
Annette	9.40	7.60	-1.8	5-7	4-4	-1yr3mo
Donna	9.90	8.20	-1.7	5-8	4-7	-1yr1mo
Ed	8.30	7.00	-1.3	4-8	3-8	-1yr

It is interesting to note however, that Linda's score increase approached one standard deviation, while the scores of the remaining I.E. students showed decreases. The decreases among I.E. students appeared to be less marked than among regular program students. It would appear that

the declining scores of the students are potentially explained by a choice, on their part, to speak more simply in June than they had in September. It is ambiguous therefore, as to whether even Linda's score change is meaningful. It would appear that the elaboration and precision of language reported in I.E. class is not reflected in these results.

It had been anticipated that due to the influence of I.E. programming, I.E. students may show change in their spontaneous language samples in at least three areas. They may attempt to be more precise in their selection of indefinite pronouns and noun modifiers thereby showing an increase in this structure. Because of projecting relationships between objects and events through inferential, hypothetical, and causal thinking they may require an increased use of conjunctions as well as more precise verb tenses to sequence these relationships. Thus, they may show increased scores in the areas of conjunctions as well as primary and secondary verbs. Therefore, these areas were examined more closely by analysing the Total Developmental Sentence Score into its component parts to potentially reveal these changes in the I.E. students' use of indefinite pronouns, verb forms, and conjunctions. As shown in Tables 9 and 10, it is interesting to note that for each of these structures the most positive score changes were attained by individual I.E. students - Linda, Janet, or Sandra.

TABLE 9

Analysis of Indefinite Pronouns and Conjunction Usage Contributing to Total Developmental Sentence Score Results

	Indefinite Pronouns			Conjunctions		
I.E. Program	Sept	June	Change	Sept	June	Change
Linda	1.20	1.37	+0.17	0.69	1.03	+0.34
Janet	0.82	1.36	+0.54	1.53	0.84	-0.69
Sandra	1.05	1.59	+0.54	1.20	0.51	-0.69
Ava	0.89	1.24	+0.35	0.78	0.46	-0.32
Regular Program						
Annette	1.65	1.07	-0.58	1.51	0.59	-0.92
Donna	1.69	2.00	+0.31	1.46	0.90	-0.56
Ed	1.65	1.56	-0.09	1.25	0.77	-0.48

TABLE 10

Analysis of Primary and Secondary Verb Usage Contributing to Total Developmental Sentence Score Results

	Primary Verb			Secondary Verb		
I.E. Program	Sept	June	Change	Sept	June	Change
Linda	2.00	2.23	+0.23	0.88	0.57	-0.31
Janet	1.53	1.83	+0.30	0.40	0.88	+0.48
Sandra	1.98	1.68	-0.30	0.57	1.51	+0.94
Ava	2.01	1.38	-0.63	0.56	0.54	-0.02
Regular Program						
Annette	2.21	1.75	-0.47	0.51	0.45	-0.06
Donna	2.00	2.08	+0.08	1.44	0.97	-0.47
Ed	2.01	1.69	-0.32	0.59	0.63	+0.01

However, in light of the similar magnitude of negative score changes shown by the remaining students, which would seem to be reflective of error factors, it would appear that the score changes may have been greatly influenced by how the students chose to speak at that time. It is possible that the students felt no pressure to be precise under the language sample conditions. Alternatively, the changes in precision reported anecdotally, may have been too small or

too infrequent to be detected by language sample procedures.

As a means of examining the four key language structures (indefinite pronouns, conjunctions, primary verbs, and secondary verbs) even more closely, a procedure which is not part of Lee's D.S.S. procedure was used. September and June graphs for each of the four structures were made to examine the distribution of the points within that structure by each student. As shown in Table 11, distribution data from the September and June language samples of the four I.E. students reflected an increase in the use of more precise noun modifiers and pronouns. In June, Linda for example, showed an 11% increase over September in her use of indefinite pronouns valued at 3-6 points. This seems to be more consistent with the use of more precise spatial referents observed and reported anecdotally.

TABLE 11

Percentage of Indefinite Pronoun Structures Valued at 3-6 Points in September and June Language Samples of the Total Frequency of all Indefinite Pronouns Observed in Sample

	Percentage			Total	
	Sept	June	Change	Sept	June
Linda	16%	27%	+11%	46	41
Janet	14%	33.3%	+19.3%	36	30
Sandra	14%	23.5%	+10.5%	66	44
Ava	10%	30%	+20%	29	17

Data did not however reflect similar increases in the more complex verb forms nor in the use of conjunctions by I.E. students. Because comparable data involving the regular program students is not available and due to the limited frequencies of these structures observed in the language samples, it is difficult to draw conclusions at this time. The distribution data from three of the four key categories seems to be consistent with the Developmental Sentence Scores in demonstrating that the linguistic precision

observed anecdotally is not generally being reflected under language sample conditions. Further research which samples student language under conditions more similar to those of I.E. class may be more successful in documenting such changes.

Second, anecdotal data appeared to provide evidence of increased attention to sequence of presentation, and adverbials of time observed primarily in two of the I.E. students (Janet and Linda). These forms of elaboration seemed to contribute clarity and precision to these students' responses. In February, Janet, for example, when asked what she was going to do on an upcoming Professional Development Day, presented her full plan: "First, I'll get up; second, have breakfast; third, phone about social insurance number ...". The question had been asked simply in a conversational way. The listener received a far more linguistically precise message than is usually required in conversation; one could not fault Janet's precision, completeness, or attention to sequence.

The April and June reading closure activities seemed to reveal similar reflections of increased linguistic precison and elaboration in three of the I.E. students' (Janet's, Linda's, Sandra's) statements of their strategies for completing the tasks illustrated in the following excerpts:

Janet (Sept):
You match the numbers that it will be makes sense. If you don't know, you just skip. Just go up and down, back and forth.

Janet (April):
First, you have to read the whole thing because you will know what kind of words you have on the paper. Second, you find the clues so you will get the words easily. Third, you figure out what kind of words you should use so you could hear or think to make sense.

Linda (Sept):
Something that sound good. It match and #1 should be it in next sentence #1. Match. See if it exactly same and sound good.

Linda (April):
First thing, I read the whole thing and see which one I can get some words. And I found a hint. Then, I think some words and put it in the blank. Just read out loud yourself or read it in your mind. See if it sound good in both. Then read it over. Make sure it sounds good.

Beginning in April, three of the four I.E. students (Janet, Linda, and Sandra) employed adverbials of time to mark sequence in the post activity strategy statement. As shown in the previous excerpts, it is interesting to note that Janet used the adverbials "first, second, third" as she had in the Professional Development Day example. The other two I.E. students (Linda and Sandra) just used "first" and "then" to mark sequence. One regular program student (Annette) used "first" and "then" to mark sequence in each of her strategy statements.

Best exemplified by Sandra's strategy, (excerpt follows) three of the four I.E. students (Janet, Linda, and Sandra) provided elaboration in their April and June strategy statements which included their reasons for

choosing that strategy; this elaboration had not been provided by the I.E. students in the September task. It was interesting to note that two of the regular program students (Donna and Ed) did not include this elaboration in any of their strategy statements though Annette had included it even in September.

> Sandra (Sept):
> My strategy is to look at the words what they have there and there are some blanks before and after it.
>
> Sandra (June):
> First, I just take a look at what it's about because I want to know what its about. If you don't know what its talking about, you won't be able to find the answers ... So I found out now and I don't know what to say at the top, the first sentences or more so I just start from the bottom and find there's the same number. Then use that first because so I could put more word the same number ... That's the easiest way but you don't know the answer in the beginning.

In summary, the three I.E. students moved from a two or three step verbalized strategy in September to strategies having five or six steps in April which now contained spontaneous elaboration for the reasons behind including key steps. These elaborations, best reflected in Sandra's statement, would appear to be supportive of the students' interest in demanding precision in themselves which was reported anecdotally.

Anecdotal data collected during the months of February and March suggested that a broadening of linguistic precision seemed to occur in Linda and Janet. The precision demonstrated appeared to be of two basic forms - demand for

precision in self, and demand for precision in others. Precision in self, as before, included more careful attention to sequence of presentation as well as precision of content. The new aspect of the behavior was that the students began to demand similar precision from others.

Janet and Linda seemed to become increasingly more aware of their own precision and came to demand similar linguistic precision of others by asking for clarification when the message appeared ambiguous or unclear. They also became curious about shades of meaning. For example, having contrasted the meaning of synchronous and sequential work in I.E. class, Janet wanted to know what a strategy would be called if it compromised the two. "What's between synchronous and sequential?" she asked.

Linda, on the other hand, particularly enjoyed pointing out when the teacher had been imprecise. For example, on March 14, Linda was especially demanding. In a discussion of the multiple meanings of the word "frog" the following notation had been made on the overhead:

frog = animal

frog = French Person

Linda interrupted by saying "That's not too precise. It could be bears or fish. Maybe you should say amphibians. That's better". She very much enjoyed reversing the challenge to the teacher who had so often issued the command "Be more precise".

Anecdotes of increased linguistic precision were reported by the teacher of I.E. and the speech/language pathologist but the I.E. students' other classroom teachers did not indicate that they were aware of such changes. In an I.E. class discussion of February 17, it was interesting to note that although Janet, Linda, and Sandra felt they had demonstrated increased precision and attention to detail, Sandra believed that their other teachers were not aware of this change. When asked why their teachers were not seeing this change, the four I.E. students revealed that they do not participate in the class discussions in their other courses. It was interesting to note however, that although other classroom teachers were not aware of any changes in the three students' precision related to use of language, Linda's Commercial Art teacher did report, in a February 28 case conference, that he had observed improvement in Linda's neatness and attention to detail in her art work since Christmas.

It was anticipated that the behaviors reported with respect to linguistic precision would be reflected in the level of elaboration observed on the Formulated Sentences Subtest of the CELF. As shown in Table 12, agrammatical and unelaborated simple sentence types accounted for 9-11 of the 12 sentences produced by I.E. and regular program students in September; it was therefore expected that in June I.E. students would show longer and more elaborated constructions than they had in September whereas the regular program

students would not. This was not the case.

TABLE 12

Number of Agrammatical and Unelaborated Simple Sentences Produced on the Formulated Sentences Subtest of the CELF Out of a Possible 12 Formulations

	Incomplete or Agrammatical Sentences			Unelaborated Simple Sentences		
I.E. Program	Sept	June	Change	Sept	June	Change
Linda	5	5	0	6	0	-6
Janet	5	6	+1	4	2	-2
Sandra	5	6	+1	5	5	0
Ava	5	1	-4	4	0	-4
Regular Program						
Annette	2	1	-1	7	0	-7
Donna	7	6	-1	4	0	-4
Ed	6	7	+1	5	4	-1

As shown in Table 12, three of the I.E. students (Linda, Janet, and Ava) did demonstrate at least some

qualitative change in their unelaborated simple sentences. In light of similar decreases in the number of simple sentences shown by the three regular program students, performances of I.E. students did not seem to differ, in a meaningful way, from that of regular program students. Further analysis revealed continued similarity between the two groups. In three of the I.E. students (Linda, Janet, Ava) and two of the regular program students (Annette and Donna) the decrease in unelaborated simple sentences was replaced by increased use, or new inclusions, of more elaborated structures as shown in Table 13.

TABLE 13

Analysis of Point Values of Sentence Constructions Produced by I.E. and Regular Program Subjects on the Formulated Sentences Subtest of the CELF

	1 Point		2-8 Points	
I.E. program	Sept	June	Sept	June
Linda	6	0	1	7
Janet	4	2	3	4
Sandra	5	5	2	1
Ava	4	1	2	10
Regular Program				
Annette	7	0	3	11
Donna	4	0	1	6
Ed	5	4	1	1

Key to Construction Values

0 Incomplete/agrammatical sentences
1 Simple sentences
2 Simple sentences with compound subject/verb/object
3 Simple sentences with phrases
4 Compound sentences
5 Negative sentences
6 Interrogative sentences
7 Complex sentences with subordinating conjunction
8 Complex sentences with relative clauses and/or embedding

Similarities with respect to elaboration were also reflected in increased Mean Length Utterance (M.L.U.) of the formulations produced by three I.E. students (Linda, Janet, and Ava) and one regular program student (Annette) as shown in Table 14.

TABLE 14

Mean Length Utterance of Sentences Produced on the Formulated Sentences Subtest of the CELF

I.E. Program	Sept	June	Net Change
Linda	5.83	7.58	+1.75
Janet	6.17	9.08	+2.93
Sandra	4.75	4.83	+0.08
Ava	6.08	7.08	+1.00
Regular Program			
Annette	5.58	6.50	+0.92
Donna	8.08	7.67	-0.41
Ed	5.53	5.00	-0.33

It is interesting to observe that the M.L.U. increase shown by the regular program student (Annette) was less marked than those of the three I.E. students (Linda, Janet, and Ava). It is not clear however, whether or not these increases are meaningful due to lack of norming data in this regard. However, qualitative changes in the three I.E. students may not be unlike that observed in the two regular program students.

It is interesting to note from Table 15 that the qualitative changes in the performances of three of the I.E. students (Linda, Janet, and Ava) on the Formulated Sentences Subtest appear to have resulted in quantitative changes cautiously translating to two and three grade levels (or one and two standard deviations) in the scores of two I.E. students (Linda and Ava).

TABLE 15

Performances by I.E. and Regular Program Students on the Formulated Sentences Subtest of the Clinical Evaluation of Language Functions

	Raw Scores			Grade Equivalents		
I.E. Program	Sept	June	Change	Sept	June	Change
Linda	12	26	+14	K	2	+2
Janet	18	21	+3	1	1	+0
Sandra	15	11	-4	1	-K	-2
Ava	6	31	+25	-K	2	+3
Regular Program						
Annette	22	47	+25	1	10-12	+10
Donna	8	21	+13	-K	1	+2
Ed	11	10	-1	-K	-K	+0

However, as shown in Table 15, two regular program students (Annette and Donna) also showed score changes of one and two standard deviations. In Annette's case this is explained by the fact that in September although Annette was

very familiar with interrogative formulations she chose to produce only two such formulations but in June she chose to produce five, thus artificially inflating her score. There are no such anomolous circumstances to account for the change in Donna. It would appear that there seems to be some reflection of increased elaboration among three of the I.E. students but it is questionable as to how meaningful these changes may be in light of similar qualitative or quantitative changes in two regular program students.

Further research which involves larger samples and more subjects in examining the level of elaboration in language produced by I.E. students may be more conclusive.

In summary, anecdotal reports suggested that individual I.E. students appeared to demonstrate increased demand for precision in themselves and in others. Though the change was most marked with respect to linguistic precision, other forms of precision such as neatness and attention to detail were also observed. Contributions to linguistic precision were observed in generalization of I.E. vocabulary and concepts as well as more precise use of pronouns. In addition to the inclusion of adverbials of time, greater attention to sequence and more precise use of spatial referents and spontaneous elaboration of detail were also observed. Changes appeared to be highly individualized and were not necessarily carried over into testing situations in ways which were clearly meaningful.

E. Demand for Logical Evidence and Logical Thinking

In September, anecdotal observations made by the teacher of the hearing impaired and speech/language pathologist suggested that three I.E. students (Janet, Linda, and Ava) and the three regular program students (Annette, Donna, and Ed), appeared to be similar with respect to their limited reliance on use of logical evidence and logical thought. Reports indicated that exploration of alternatives and multiple solutions in an academic setting was very difficult for the students, yet in interpersonal settings it was not problematic. For example, members of both groups willingly listened to the opinions of others and responded with sensitivity, yet it was particularly typical of two I.E. students (Janet and Ava) and two regular program students (Annette and Donna) to be unable to transfer this cognitive efficiency with respect to multiple alternatives to an "academic" setting. Rather than suggesting and accepting a variety of possible responses for a problem, concern appeared to be for generating the one "right answer". For example, brainstorming was a very difficult task for the students. Similarly, there appeared to be no exploration of alternatives in decision making as no alternatives were generated. It was interesting to note however, that Sandra did not display comparable difficulty in this area.

Across the course of the program, three potential areas of change in self regulatory behaviors of individual I.E.

subjects were observed and appeared to be related to their use of logical evidence and logical thought:

1. Increased willingness to explore multiple alternatives and solutions
2. Increased willingness to spontaneously support statements with logical evidence
3. Emergence of verbalized hypothetical thinking

First, exploration of alternatives in problem solving was an area showing change in three I.E. students (Janet, Linda, and Sandra). It was observed as early as December in the form of more successful brainstorming. For example, the student group, composed of three I.E. students (Janet, Linda, and Ava) and one regular program student (Ed), generated 15-20 items per category; all but two of the contributions were made by the three I.E. students with more items generated by Linda or Janet than by Ava. Later that day, the same activity was presented to two regular program students (Annette and Donna) in a different class. As a team they generated only two items per category.

Consideration of multiple alternatives appeared to remain underdeveloped in the regular program subjects. The idea that each problem had only one acceptable solution seemed to persist across the year in the behaviors of regular program students (Annette and Donna) but also to some degree in one I.E. student (Ava). For example, Donna and Annette appeared to find it very difficult to generate more than one answer. This difficulty was exemplified

whenever a brainstorming activity was in progress and they were called upon to respond second or third in turn; they had difficulty generating additional alternatives. Multiple alternatives appeared to be a concept which the regular program students continued to find very difficult whereas three of the I.E. students (Janet, Linda, and Sandra) seemed to find increasingly more natural.

Data from the June reading closure strategy interviews of three of the I.E. students (Janet, Sandra, Linda) seemed to reflect similar interests in exploring and evaluating multiple alternatives. Observations made during completion of the September reading closure activity suggested that the four I.E. students and two regular program students (Donna and Ed) appeared to be writing in the first alternative they could generate without first reading the latter part of the sentence. This approach is well illustrated by Ed's strategy statement: "I just put a guess. It might be right or not". As a result of this lack of exploration of alternatives and lack of hypothesis testing, erasures were required once further information was gathered. These behaviors may suggest that the students were having difficulty working simultaneously with multiple sources of information and collecting and evaluating multiple hypotheses.

In June, however, where the three regular program students (Annette, Donna, and Ed), continued to verbalize a single potential solution for each blank and immediately write it in, in several instances, three of the I.E.

students (Sandra, Janet, and Linda), generated two or three alternatives prior to making a choice. Sandra verbalized this point in her strategy: "You could think of a word, could be more than three". The importance of collecting and exploring several alternatives prior to making a decision had been a frequently discussed concept in I.E. programming and therefore may have been transferred.

As shown in the excerpts below, the four I.E. students also verbalized in their reading closure strategies that one must systematically test hypotheses; the four I.E. students referred in their strategies to testing their hypothesis in multiple contexts.

Linda (April):
Just read out loud yourself or read it in your mind. See if it sound good in both.

Ava (April):
Look at the other numbers if it make sense because it sound right. I looking over for the other numbers if it make sense if the words ~~together~~.

Sandra (June):
Then I read over again so "disease" is the right word for it. So I want to see if "disease" make sense in the other #3 space.

Janet (June):
So when I wrote the word is "cold" and I go over another #3 and write the same word ... I think it helps me because to sound out if its right, sound out if its make sense to sound right.

The four I.E. students were observed both to work in this way as well as to verbalize this point in their

strategies. Two of the regular program students (Donna and Ed) continued to verify their choice in other contexts only after they had written it. This approach is illustrated by Donna's and Ed's strategy statements:

> Ed (June):
> And you fill up all the blank what have the same numbers on the below the same numbers ... When you finishing, go back to read it again if its good.
>
> Donna (June):
> Then figure out what the sentence and the blank. What the word supposed to be in the blank ... Then you put it in the blank. And then you go on the next set.

The two regular program students were not verifying their answer in multiple contexts prior to writing as the I.E. students were. The reading closure data would appear to be supportive of anecdotal observations relating to exploration of multiple alternatives in individual I.E. students. It would be interesting to see if further research identifies carry-over of this observation into daily life problem solving.

Second, spontaneous use of logical evidence to support one's opinion or statement appeared to become increasingly automatic for two of the I.E. students (Janet and Linda) inside, as well as outside, of I.E. class. This interest in logical evidence appeared to be demanded from themselves as well as from others.

For example, in I.E. class the students were required to justify their responses, therefore the prompt "Why do you say that?" was frequently used through the first few months

of the program. It was faded out in January when in an almost game-like fashion, Linda began to demonstrate that she no longer needed to be reminded to support her responses. She would give the opinion part of her response, pause and smile at the group members, then emphasize the word "because" very loudly and complete the response. The message was clear; no reminder was necessary. This behavior was observed both in the I.E. class as well as in the English class.

Transfer of this spontaneous use of logical evidence into written responses produced in English class seemed to be very limited perhaps because the language structures required for such use of logical evidence were difficult for the students to control in writing. Therefore when such attempts were made, weak syntax and semantics may have confounded their efforts. It would be interesting to see if research which analyzes student writing and comprehension responses for supporting detail detects change in I.E. students.

It was interesting to note that Janet and Linda quickly adopted the idea that if supporting one's response with logical evidence was expected of them, it should be expected of others. The two students became particularly demanding; they very much enjoyed challenging the teacher and the regular program student in their class (Ed) to provide supporting evidence. To a limited extent, with prompting, Ed also showed an increase in his use of logical evidence,

though it seemed to be provided in confused response to the demands of Janet and Linda.

Examination of the reading scores revealed interesting parallels to the anecdotal data with respect to use of logical evidence. As shown in Table 16, three of the four I.E. students (Linda, Janet, Ava) demonstrated score increases in June of four raw score points in literal comprehension while the fourth I.E. student (Sandra) remained unchanged from her initial high level in September.

TABLE 16

Performances on the Literal Reading Subtest of the Edmonton Public Schools Elementary Test of Reading Reported in Raw Score Out of 30

I.E. Program	Sept	June	Net Change
Linda	18	22	+4
Janet	21	25	+4
Sandra	25	25	+0
Ava	15	19	+4
Regular Program			
Annette	25	26	+1
Donna	14	14	+0
Ed	16	18	+2

Though these score changes do not translate to a full standard deviation of six raw score points, it should be noted that changes in the two regular program students (Annette and Ed) were limited to 1 and 2 raw score points respectively. Thus, while by no means being conclusive, findings appear to identify an area worthy of further

research - the influence of I.E. on literal reading.

As shown in Table 17, inferential reading scores of two I.E. students (Linda and Janet) showed only small increases of one or two raw score points which do not approach one standard deviation (4.0 points).

TABLE 17

Performances on the Inferential Reading Subtest of the Edmonton Public Schools Elementary Test of Reading Reported in Raw Score Out of 22

I.E. Program	Sept	June	Net Change
Linda	7	8	+1
Janet	12	14	+2
Sandra	15	12	-3
Ava	11	10	-1
Regular Program			
Annette	16	14	-2
Donna	13	12	-1
Ed	8	9	+1

In fact, the other two I.E. students (Ava and Sandra) showed score decreases of similar magnitudes. In light of what would seem to be the influence of error factors, it would appear that essentially no meaningful change has occurred among I.E. or regular program students with respect to inferential reading scores though it is interesting to note that, as in literal reading, Janet has shown a score change in inferential reading as well.

As shown in Table 18, critical reading scores of two I.E. students (Janet and Sandra) reflected increases of three raw score points and thus closely approximated one standard deviation (3.7 raw score points).

TABLE 18

Performances on the Critical Reading Subtest of the Edmonton Public Schools Elementary Test of Reading Reported in Raw Score Out of 18

I.E. Program	Sept	June	Net Change
Linda	4	4	0
Janet	7	10	+3
Sandra	9	12	+3
Ava	7	5	-2
Regular Program			
Annette	11	12	+1
Donna	7	7	0
Ed	10	6	-4

One regular program student (Annette) also showed a score change but it was limited to an increase of only one raw score point. Though caution must be exercised in interpreting the score changes of Janet and Sandra, the results are consistent with anecdotal data and appear to be unique in comparison to the performances of non-I.E. subjects. It is interesting to note that the two I.E.

students (Janet and Sandra) showing increases in critical reading are those students with the highest overall reading scores.

The results from the EPS test of reading comprehension suggest that individual I.E. students are performing differently in literal reading or critical reading, or both, from what they had in September. Whether these differences are truly meaningful is ambiguous at this point but clearly worthy of further research to pinpoint the nature of changes in reading comprehension performance when changes can be documented. If the changes are truly meaningful, it may be that this improvement in comprehension, particularly at the literal level, might be attributed less to improved reading ability per se, and more to improvement in the student's demand for logical evidence to support their responses. The skills required in mature reading and success on multiple choice reading tests would seem to be very much related to the exploration of multiple alternatives, as well as the spontaneous use of logical evidence and reference materials. These skills are also emphasized in Instrumental Enrichment.

Third, the final behavioral change observed was the verbalization of spontaneous hypothetical thinking which occurred later in the year. It was interesting to note that in September three of the I.E. students (Janet, Linda, and Ava) gave no indication of expressive control of the linguistic structures required for verbalization of hypothetical thought; therefore, it was unexpected that two

of these students (Janet and Linda) displayed such structures in I.E. class. For example, on April 5, Orientation in Space was the I.E. instrument under discussion and the class was debating whether a yield sign was hung with the point up or down. Since no one could recall for sure, Janet suggested, "If you turn it this way, (point up), no room to write at the top". This was Janet's first observed indication of spontaneous hypothetical thinking reflected through expressive language. Sandra built onto Janet's conditional phrase adding, "Then you would have to write at the bottom". She too had verbally demonstrated hypothetical thinking but as shown in her September reading closure strategy she had demonstrated this capability in September as well. Spontaneous verbalized hypothetical thinking was generally rare, and perhaps therefore was not observed on the language sample data or Formulated Sentences constructions on the CELF. Further research which examines hypothetical thinking in I.E. students would appear to be an interesting topic for further pursuit.

In summary, three general forms of behavioral change which appeared to be related to the use of logical evidence and logical thinking were observed in individual I.E. students and most markedly in Janet and Linda. Similar changes, observed anecdotally, were not seen in the regular program students. An increased willingness to explore multiple alternatives and multiple solutions seemed to be replacing the I.E. students' initial "one right answer" view

of the world. Increased demand for spontaneous support of statements with logical evidence was observed. This behavior was manifest in two forms - demand from self, and demand from others. Lastly, emergence of verbalized hypothetical thinking was observed late in the year. Examples of these behaviors were both rare as well as slow to develop. With the exception of Sandra, in general, the language structures required for this type of thinking aloud were not easily controlled by the I.E. students. At least some reflection of the behaviors observed may have been seen in the results of the literal and critical reading subtests; score changes in some individuals approached, but did not equal, one standard deviation.

F. Summary of the Results and Discussion

During the year, anecdotal reports indicated changes in five areas in individual I.E. students: planning and restraint of impulsivity; student responsibility for learning; generalization; demand for precision; demand for logical evidence and logical thinking. These changes were not primarily quantitative in nature. In fact, there was generally little quantitative support for these behaviors in the results from standardized measures. Instead, it was the I.E. students' strategies, or approaches, to problem solving which showed change; the regular program students did not seem to reflect similar strategic changes based on anecdotal data.

A differential effect of the program also appeared to be observed. Anecdotal records as well as results from standardized measures revealed that Janet appeared to more consistently demonstrate change than any of the other I.E. students. By contrast, Ava appeared to be least changed qualitatively and perhaps quantitatively as well. Each of the four I.E. students seemed to have behaviors, or cognitive functions, which were more amenable to change than others.

It was interesting to note that in September although Sandra did not seem to display deficiencies in the above mentioned five areas, during the year she also seemed to refine her skills particularly in generalizing from one situation to another as well as becoming more aware of her

cognitive efficiencies. This was most notable with respect to planning. Quantitative changes where they were observed were small with the exception of her score change on the Relationship and Ambiguities Subtest of the CELF which may be related to her growth in generalizing.

A differential effect may also have been observed with respect to generalization of behaviors to new contexts. Four instruments appeared to show at least small score changes in individual students which were consistent with anecdotal observations - the reading closure tasks, two subtests of the EPS Elementary Test of Reading, (Literal Reading and Critical Reading), and three subtests of the CELF (Word Classes, Word Associations, and Formulated Sentences). It should be noted that score changes approaching one standard deviation were also made by one of the three regular program students in each of three subtests of the CELF - Word Associations, Word Classes, and Formulated Sentences. It was not however, the same student in each case.

In comparison, the scores from three measures showed little or no change - Student's Perception of Ability Scale, CTBS - Mathematics Problem Solving, and the Developmental Sentence Scoring analysis procedures used on spontaneous language samples. Further research would be of value to discover whether or not I.E. students having two or three years of training would show change on these measures.

Anecdotal evidence suggested that individual I.E. students demonstrated evidence of beginning remediation of

cognitive deficiencies in five basic areas; these changes were seen to varying degrees in individual students but were not observed among regular program students.

Firstly, in three of the I.E. students, observational data indicated to varying degrees that impulsive behavior was apparently being replaced by restraint and increased planning behavior. Some reflection of these behaviors in individual I.E. students appeared to be seen in three other data sources: reading closure tasks, the Standard Progressive Matrices, and the CELF Word Associations Subtest. Though regular program students did not appear to show change based on anecdotal or reading closure data, one regular program student did show a raw score change on the CELF Word Associations subtest approaching one standard deviation; it did not translate to a meaningful change in grade equivalent.

Secondly, it was observed that, in each of the individual I.E. students, passivity was apparently replaced by increased willingness to assume responsibility for learning. This was observed to varying degrees in individual students. Unexpectedly, reflection of these changes was not obtained from the "irregular" results of the Student's Perception of Ability Scale. Though regular program students did not appear to show change in this area based on anecdotal data, one regular program student did show a raw score increase approximating one standard deviation which seems to be very consistent with her personality.

Thirdly, in three of the I.E. students, observational data revealed that lack of spontaneous comparative behavior was apparently being replaced as the three students began to generalize, or to bridge, what had been learned in Instrumental Enrichment class to other fields. Reflection of these behaviors appeared to be seen in two other data sources: the Word Classes, as well as, the Relationships and Ambiguities subtests of the CELF. Unexpectedly, the CTBS Mathematics Problem Solving test did not provide additional support. Though regular program students did not appear to demonstrate anecdotal evidence of change with respect to comparative behavior, on each of the two CELF subtests, one regular program student did show a raw score change approaching one standard deviation; the meaning, however, of these score changes is not clear with respect to grade equivalents.

Fourthly, in each of the four I.E. students it was observed, to varying degrees in individual students, that students became increasingly more demanding of precision in their work and in their use of oral language. Reflection of these behaviors appeared to be seen by two other data sources: the reading closure activity and the Formulated Sentences subtest of the CELF. Regular program students did not evidence change in this area based on anecdotal or reading closure data. However, one regular program student did demonstrate a score change on the Formulated Sentences subtest which appears to be meaningful.

Fifthly, in three of the I.E. students, observation suggested that the students' initial lack of need for logical evidence was apparently being replaced by a demand for such evidence and the enhancement of logical thinking, including making inferences, drawing conclusions, hypothetical thinking, and critical thinking. Reflection of these behaviors appeared to be seen in three other data sources: the reading closure tasks, as well as the literal and critical comprehension subtests. Similar changes in regular program students were not observed in the anecdotal, reading closure or reading comprehension data.

The anecdotal observations provided the greatest indicators of potential change, though confirmation of change by standard measures was sparce. Perhaps it is because these "microchanges" or work habits and strategies are newly emerging, and therefore somewhat unrefined and cumbersome, that relatively small quantitative reflections of change were seen in standardized measures. It is possible that with more training these evolving functions will become more automatic, more easily applied, and therefore more readily quantified.

It should be noted however, that this research has identified a number of behaviors which at least anecdotally, appear to have shown change. Further research which formally samples and quantifies behaviors, such as those from the five potential areas of change discussed in this research, may be valuable in helping educators to understand the

effects of Instrumental Enrichment on hearing impaired adolescents.

Though it was not the intention of this researcher to investigate the effects of Instrumental Enrichment on the teacher, effects were observed. In the present study, involvement in Instrumental Enrichment created a source of pressure on the teacher to focus on the process of learning, rather than on its products, and therefore to implement this process approach in non-I.E. lessons and in other types of student-teacher interaction.

Three main components of this philosophy, as it was implemented in the I.E. lessons, became sources of pressure when, for research purposes, these components were deliberately not implemented outside of I.E. class. The first aspect of the discomfort related to the teacher's interest in using the structure of a typical I.E. lesson plan as a model for planning non-I.E. lessons so they too would have a metacognitive component. This process approach would be addressed primarily in the introduction to the lesson and the discussion of strategy following the students' independent work. The second aspect of the pressure revolved around teacher's expanded interest in using the mediating questioning routines from I.E. class which were not only intended to elicit correct answers but also the exploration of alternatives, justification of the response and a discussion of how the students arrived at, or planned to arrive at, their answers (eg. "Why?" "How do you

know?" "What else ...?" "What if ... ?" "How do you plan to... ?"). The third aspect of the pressure related to the teacher's desire to consistently raise her expectations for student responses, as had already occurred in I.E. class, by pushing the students for the most complete, most precise, and most insightful response they could provide rather than simply accepting a lesser quality response because of the students' impairments.

In the present study, it should be noted that Instrumental Enrichment became more than a course of study; it became a "philosophy" toward teaching founded on three main constructs - metacognition, mediation, and active modification.

V. Conclusions

The objective of this research has been to probe for, and to describe, changes in the cognitive development of hearing impaired adolescents for the purposes of drawing preliminary conclusions regarding the usefulness of pursuing Feuerstein's theory and his Instrumental Enrichment program with hearing impaired populations. It was also intended that this research would contribute to the identification of specific topics which may, through further research, enhance understanding of the relationship of thought, language, and hearing impairment.

In keeping with the goals of this research, this chapter will consist of two major sections. First, a discussion of the significant findings and conclusions will be presented. Second, a number of topics worthy of future research will be discussed.

A. Significance of Findings

It is the changes in logical thinking which are of particular interest to this researcher. It appears to be these thinking processes, including inferential thinking for example, which are weak in hearing impaired students (Crandall, 1982; Sarachan-Deily, 1985), yet which are critical for students to move to higher levels of cognitive functioning. In chapter one a composite case description illustrated the lack of higher orders of thought and the resulting episodic grasp of reality in a hearing impaired

student named John. Emphasis, through analogy, was given to the incompleteness of John's cognitive "map of the world". Within John's cognitive framework, he did not construct for himself inferential pathways interconnecting his islands of knowledge; nor, it would seem, did he have the tools or feel any need to do so.

Like John, the hearing impaired adolescents in this study did not seem initially to have the tools, or feel the need, to generalize their understanding of one set of experiences to another. As a result, the students may not have felt responsible for spontaneously comparing, projecting relationships, or for thinking inferentially. It would appear that the students perceived themselves as "collectors" of knowledge rather than "generators" of knowledge and therefore did not assume the role of manufacturing information through inference.

The findings of this research provide descriptive anecdotal data suggesting that deficient cognitive functions, contributing to lack of inferential and critical thinking, showed "glimmers" of development during participation in one year of programming in Instrumental Enrichment. These findings are consistent with the changes reported by other researchers after one year of Instrumental Enrichment training (Narrol et al., 1982, Martin, 1984) but not as dramatic as the changes reported by other researchers after two or three years of training (Rand et al., 1979; Martin, 1984; Jonas & Martin, 1985).

Though an attempt was made by this researcher to select standardized measures which would be potentially more sensitive than those already tested by other researchers (Arbitman-Smith & Haywood, 1980; Narrol et al., 1982) it is also consistent with the existing research that the behavioral and strategic changes reported in individual I.E. students participating in this study showed little general transfer to the measures chosen. Clearly, however, one I.E. student (Janet) appeared to be more greatly influenced than the other students as reported in the anecdotal data as well as in the data from standardized measures.

Three conclusions have emerged. First, individual hearing impaired adolescents did, concurrent with their participation in Instrumental Enrichment, demonstrate microchanges in cognitive development which regular program subjects did not. These changes were seen in varying degrees and in differing areas with one student, Janet, being more greatly and more generally influenced than the other students. This would appear to suggest that the program has differential effects on individual students which should be recognized and pursued. If behavioral signs of the development of deficient functions seem to be surfacing after only 100 hours of Instrumental Enrichment programming, then the potential for continued and measurable progress by completing the full program would appear to be real and worthy of further pursuit by educators of the hearing impaired. Continued efforts must be made by researchers to

select sensitive instruments. One vehicle may be through quantified anecdotal records.

Second, Feuerstein's concept of deficient cognitive functions has provided a very useful framework through which to study cognitive development as reflected in the performance of hearing impaired adolescents. If pursued by educators of the hearing impaired, this model, emphasizing the "prerequisite skills" to thinking, may lead to a better understanding of the delays in development of thought and language displayed by hearing impaired children.

Third, and perhaps most significantly, Feuerstein's concept of mediated learning experiences and cognitive modifiability, has the potential for providing a valuable theoretical model for the systematic development of efficient "thinking habits" in young children thereby minimizing developmental delays.

B. Suggestions for Further Research

It is exciting that this research has provided an opportunity to observe positive changes in the self regulatory behaviors of hearing impaired adolescents even though these changes did not generally translate into performance changes on standardized measures. That this research may, in some way, contribute to local interest in pursuing the applicability of Feuerstein's concepts of deficient functions, mediated learning experiences, and cognitive modifiability in understanding the relationships

between thought, language, and deafness is also exciting.

Beyond these two main contributions, this research has generated far more questions than it has answered regarding the use of Instrumental Enrichment with hearing impaired adolescents. Following is a discussion of several questions worthy of future research. Potential topics within two main areas are discussed:

1. Use of Instrumental Enrichment Programming
2. Further Studies in Deafness

Use of Instrumental Enrichment Programming

Bradley (1983) expressed concern that, like procedures for ability training seen in 1961, Instrumental Enrichment may rise in popularity faster than its research base can support. To date, there are no longitudinal studies following up children of various populations three to five years after completing the full Instrumental Enrichment program and thus replicating Feuerstein's (1980b) documentation of self perpetuating structural change. In addition, recent two and three year studies in which students of various populations complete the full I.E. program are also seriously lacking. Ever present in the conclusions of existing research is a recommendation for further research involving larger groups of subjects, more complex designs, and longer research periods (Haywood & Arbitman-Smith, 1981; Narrol et al., 1982; Martin, 1984).

In light of rising public interest in cognitive education, the relative lack of recent longitudinal research, and the ever increasing momentum in the spread of Instrumental Enrichment (Link, 1980), Bradley's caution appears to be well founded. Continued research documenting the longterm effectiveness of completion of the full Instrumental Enrichment program is clearly required with all populations to ensure that the program does not overtake its research base.

Research involving hearing impaired subjects is particularly lacking. To date, the work of Martin (1984) and Jonas and Martin (1985) are the only studies involving hearing impaired subjects available in the journals. Understandably, because hearing impaired adolescents comprise a small population, research has generally been sparce and on a small scale.

However, a second factor also contributes to this lack of available research. It appears that Instrumental Enrichment is being piloted in a number of centres with hearing impaired students (J. Towery, personal communication, August 22, 1985), however, this research is not being published. Increased efforts to communicate results within the field of education and deafness would contribute significantly to overcoming the observed deficits in research involving the use of Instrumental Enrichment with hearing impaired populations.

Despite the small numbers of hearing impaired subjects involved in existing research, designs have consistently emphasized quantitative rather than qualitative data. Existing studies have laid a statistical framework upon which more indepth and descriptive research may be founded to investigate the actual process of change.

With respect to the use of Instrumental Enrichment with hearing impaired students, questions in five areas have emerged and provide starting points for further research.

First, the literature in hearing impairment indicates that impulsivity among hearing impaired children exceeds that found in their hearing peers (Schlesinger & Meadow, 1972; Altschuler et al., 1976). Yet, increased restraint of impulsivity and increased planning behaviour, linked to participation in only one year of Instrumental Enrichment, has been documented in this study as well as by Martin (1984) and Jonas and Martin (1985). Further research examining more specifically the process of the development and generalization of strategies of impulsivity restraint through Instrumental Enrichment programming would be valuable.

Second, improvement on tasks demanding nonverbal problem solving skills, such as Raven's Standard Progressive Matrices, seems to be consistently reflected in the literature on Instrumental Enrichment. Though Martin (1984) observed an average of three raw score points of improvement after the first year of I.E. programming and eight points

after two years, little is known about the possible changes in actual processes hearing impaired students use in completing the task. Further research involving clinical interviews might address this concern.

Third, consistently, studies including this one, have been unable to obtain significant results in the area of changes in self concept and academic self concept linked to Instrumental Enrichment programming. Yet, anecdotal observations seem to indicate that such change has already occurred. Investigations which explore the relationships between the performance of hearing impaired children and what they perceive their role to be in the learning/thinking process, would be valuable both including and excluding any contributions made by Instrumental Enrichment.

Fourth, this study did not detect the changes in mathematics problem solving skills that were expected. It is not completely clear why the students did not improve. One explanation is that because Instrumental Enrichment instruction did not bridge into this area, students did not spontaneously generalize their newly developing strategies. A second, and perhaps more insightful explanation, is that the students may have generalized their level I strategies, but certain functions remained deficient, because they were not specifically remediated in the level I instruments. More careful examination of the effects of one, two, and three years of Instrumental Enrichment programming from the point of view of correction of deficient functions may be helpful

in predicting its effect on specific academic, cognitive, or possibly social areas.

Fifth, to date, all of the published research on the use of Instrumental Enrichment centres on changes in the student. Researchers have yet to examine the way in which Instrumental Enrichment training affects teaching styles and methodology. Children are showing benefit from I.E. programming and it is unlikely that this benefit can be explained simply as a function of the I.E. materials themselves. It is, therefore, important that researchers explore the other major factor - the teacher-mediator. Research which promotes understanding of the role of the teacher as a mediator may have significant effects on the curriculum and instruction components of teacher training programs.

Further Studies in Deafness Within the Feuerstein Framework

The research in deafness and Instrumental Enrichment appears to indicate that Feuerstein's theory can be usefully applied to explain why some hearing impaired students develop with no impairment in cognitive functioning while others, having similar degrees of hearing loss, become retarded performers. To date, educators of the hearing impaired have lacked a cohesive theory in which a single construct could simultaneously explain "the high achievers" and "the retarded performers". Therefore, of particular relevance to further research in hearing impairment are

three of Feuerstein's major constructs:

1. Mediated Learning Experiences
2. Deficient Cognitive Functions
3. Active Modificational versus Passive Acceptant Approaches to Education

First, studies in parent-child communication have already documented some noteworthy differences in the way in which hearing parents and children interact as compared with the interactions of hearing parents and their hearing impaired children (Schlesinger & Meadow, 1972; Knee, 1974). If, as Feuerstein believes, a central function of the early communication interactions parents offer their children is to help them understand their experiences thus laying the foundation for further training, then it is clearly a process to which many hearing impaired children have limited access. Access to mediation may be limited both in quantity as well as quality. Therefore, a better understanding of the processes of parent child communication, and the potential for enhancing these process in families with hearing impaired children, is essential.

Second, recent studies in the cognitive development of hearing impaired populations have repeatedly documented normal intelligence on nonverbal measures (Rosenstein, 1961; Furth, 1966a; Vernon, 1967, 1969). Discrepencies between the performances of deaf and hearing subjects have been found on certain tasks (Levine, 1976; Liben, 1978; Quigley & Kretschmer, 1982). To date, the inconsistencies between the

performances of hearing and hearing impaired subjects on cognitive tasks have been explained by experiential and linguistic deficits. While the explanations are simple and obvious, they have contributed little specific information towards the remediation of the problem. Investigation of the processes and functions underlying successes and failures of various subgroups of hearing impaired students on these tasks may be of greater impact.

Third, there is some evidence to suggest that teachers of the hearing impaired may not adequately mediate their students and pressure them to climb to higher levels of performance (Meadow, 1980; Webster, Wood, & Griffiths 1981; Keane, 1985). Research in the area of teachers' perceptions of the potential of their students and their effects on classroom expectations and instruction must also be pursued.

C. Conclusion

Though Feuerstein's work, his program and his constructs are not likely to be the only key to understanding the processes of cognitive development among hearing impaired children, it is clearly time for new ideas in programming and for new frameworks for further research in deafness. That the levels of academic achievement have essentially remained unchanged for the past twenty years is evidence that despite ongoing research, teachers of the hearing impaired are little more successful in helping students reach potential than they were twenty years ago.

The interrelating processes of language and cognition are still only poorly understood at best and it would appear that there are many questions yet to be answered. Feuerstein's model appears to be a powerful and a useful one both to teachers and to researchers in hearing impairment if the choice is made to pursue it.

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Appendix A
Location and Nature of Deficient Cognitive Functions

Input Level

1. Blurred and sweeping perception
2. Unplanned, impulsive, and unsystematic exploratory behavior
3. Lack of, or impaired, receptive verbal tools that affect discrimination (ie. objects, events, relationships, etc., do not have appropriate labels)
4. Lack of, or impaired, spatial orientation; the lack of stable systems of reference impairs the establishment of topological and Euclidean organization of space
5. Lack of, or impaired, temporal concepts
6. Lack of, or impaired, conservation of constancies (size, shape, quantity, orientation) across variations of other dimensions of the perceived object
7. Lack of, or deficient need for, precision and accuracy in data gathering
8. Lack of capacity for considering two or more sources of information at once; this is reflected in dealing with data in a piecemeal fashion rather than as a unit of organized facts

Elaborational Level

1. Inadequacy in the perception of the existence and definition of an actual problem
2. Inability to select relevant versus nonrelevant cues in defining a problem
3. Lack of spontaneous comparative behavior or limitation of its application by a restricted need system
4. Narrowness of the cognitive field
5. Episodic grasp of reality
6. Lack of, or impaired, need for pursuing logical evidence
7. Lack of, or impaired, interiorization
8. Lack of, or impaired, inferential-hypothetical ("iffy") thinking
9. Lack of, or impaired, strategies for hypothesis testing
10. Lack of, or impaired, ability to define the framework necessary for problem solving
11. Lack of, or impaired, planning behavior
12. Nonelaboration of certain cognitive categories because the verbal concepts are not a part of the individual's verbal inventory on a receptive level or they are not mobilized at the expressive level

Output Level

1. Egocentric communication modalities
2. Difficulties in projecting virtual relationships
3. Blocking (anxiety-induced inability to respond)
4. Trial-and-error responses
5. Lack of, or impaired, verbal tools for communicating adequately elaborated responses
6. Lack of, or impaired, need for precision and accuracy in communicating responses

Reprinted from Narrol and Giblon (1984) pages 35 and 36

Appendix B
Descriptions and Goals of Level I Instruments

Organization of Dots: Students must connect dots in order to project into an amorphous cloud of dots overlapping geometric figures of increasing complexity, beginning with squares and triangles, and ending with various redefined shapes.	Projection of virtual (implied) relationship; definition and labelling of forms; analysis of differences among characteristics of different but similar forms; internal representation and mental transformation of forms from different orientations; systematic search strategies; planning; use of cues; comparision, use of standard model; self-checking and spontaneous correction; precision and accuracy; principles of organization
Orientation in Space I: Students work with concepts of left, right, front and back on two-dimensional plane using paper and pencil.	Attempt to break the egocentrism of the child, teaching him or her to divide space and to organize it in objective terms, to be able to see more than one alternative at once, and to think hypothetically; teach the child to see the relationship between objects and self and between self and others
Comparisons: Students work with relationship of sameness and difference.	Use of precise descriptive terms; spontaneous comparison; alternative dimensions of comparing; determination of relevant and irrelevant dimension; identifying difference and similarity; distinction between perceptual and semantic characteristics; continuum of concrete to abstract characteristics; grouping by definitions
Analytical Perception: Students work with the whole and its parts on a two dimensional plane in an effort to isolate the single parts of a total complex	Analysis of whole into parts; relationships among parts; levels of analysis--any part is a whole and can also be broken into more parts; alternative ways of analysing the same thing; natural and artificial ways of analysing; equality and inequality of parts; summative behavior; systematic search strategies; conservation of form and size; comparison--match to sample-- as in repairing something broken; figure-ground perception

Reprinted from Pace (1983) handout.

Appendix C
Description of I.E. Students

Linda

Background Information:
Linda, aged 18-8, possessed a severe sensorineural hearing loss in the left ear and a profound loss in the right ear (PTA R=98dB; L=83dB) which had been acquired prelingually. In addition to her hearing loss, Linda was blind in her left eye. In September, 1983, administration of the CELF estimated her language processing and production ages to be 7-7 and 7-1 respectively.

Unlike many of the hearing impaired students at the school, Linda's closest friends were hearing students she had met in her classes. This friendship, in part seemed to revolve around her keen interest in art and hockey; she was an ardent Edmonton Oilers fan.

Linda's vocational area of training was commercial art which, with post secondary education, would lead to employment as a commercial signwriter. It was observed that in all of her subjects, Linda typically had up and down days for which no explanation could be found. Her performance, as well as her moods and frustration level, showed significant peaks and valleys.

Summary of Behavioral Changes:
In September deficient cognitive functions were noted with respect to each of the five major areas discussed (planning and restraint of impulsivity, responsibility for learning, spontaneous generalizing, need for precision and use of logical evidence). It was interesting to observe development across the I.E. year in each of the areas. Linda became more systematic in her work and demonstrated hypothesis testing strategies and delayed response times which appeared to contribute to fewer erasures in her I.E. work. Increased responsibility for her own learning seemed to be reflected in her more spontaneous use of reference materials, notetaking, and use of the teacher as an information confirmer (particularly of word spellings) rather than an information giver. Increased attention to relevant cues and more spontaneous comparative behavior seemed to contribute to her increased ability to bridge between I.E. and other areas. Increased precision was observed by her commercial art teacher with respect to her attention to neatness and detail. Increased linguistic precision was also observed. Greater exporation of alternatives and logical evidence appeared to underlie improvements in logical thinking.

Janet

Background Information:
Janet's most recent audiological assessment reported a moderate to severe bilateral sensorineural hearing loss (PTA R=67dB; L=77dB) which had been prelingually acquired. Aged 18-8, Janet's language processing and production ages were estimated at 8-0 and 7-10 respectively based on administration of the CELF in September 1983.

Janet was a bit of a loner in the sense that she spent very little time with her peers but instead visited frequently with the staff of the hearing impaired program before school and during breaks. She was a very serious student and worried about being successful. Janet's vocational area of study was business education via which she planned to pursue employment as a typist.

It was observed that both within the hearing impaired program as well as in her mainstream classes Janet's behavior reflected passivity; she frequently asked questions which she could have answered herself through more reflection or through the use of reference materials. Misunderstandings in oral communication were frequent as Janet often only gathered part of the required input prior to responding; impulsivity interfered with her performance. Communication was egocentric and imprecise in the sense that the listener had to probe for central and clarifying details through questioning.

Summary of Behavioral Changes:
Across the year of I.E. participation it was interesting to note that Janet seemed to be far more greatly influenced by the program than the other students. She participated freely in the I.E. discussions and often had to be subdued to provide an opportunity for her less assertive hearing impaired classmates from I.E. to participate. Like Linda, changes were observed in each of the five major areas investigated. Hypothesis testing strategies, delayed response times, more systematic work, and increased checking behavior seemed to suggest improved planning and restraint of impulsivity. Increased responsibility for her own learning was observed not only in I.E. and English class but also by her vocational teacher. This was reflected in increased use of reference materials and discrimination between essential and nonessential questions; she also began to use the teacher as an information confirmer rather than an information giver. Increased attention to relevant cues and more spontaneous comparative behavior may have contributed to her observed success in bridging from I.E. to other areas. Janet was quick to incorporate I.E. vocabulary into her conversation particularly in discussing the issues of precision and impulsivity. Spontaneous use of logical evidence and exploration of alternatives was also observed.

Sandra

Background Information:
Sandra's audiological assessments reported a severe bilateral sensorineural hearing loss (PTA R=75dB; L=83dB) which had been acquired prelingually. Aged 18-0, Sandra's language processing and production ages were estimated at 8-7 and 8-2 respectively. Sandra's vocational area of study was Beauty Culture via which she planned to become employed as a hairdresser upon graduating.

For the most part, Sandra's closest friends were other hearing impaired students; her best friend was Ava with whom she had gone to school since elementary school. Sandra was active as a school cheerleader and eventually became the captain of the squad. She was recognized as a diligent and hardworking student.

Summary of Behavioral Changes:
Though in September there were no significant deficiehcies in the five areas under investigation it was interesting to note that improvements were still observed. More delayed responses as well as more systematic approaches to problem solving were observed. While Sandra was not impulsive herself, she improved in this area in the sense that she began to mediate to this deficiency in others. Increased responsibility for her own learning was reflected in notetaking behavior, use of questions, and in use of teacher as an information confirmer. An increase in her willingness to participate in the I.E discussions was also observed. Initially she had participated very little not it seemed because she had difficulty following but more likely due to shyness or passivity, or both.

Ava

Background Information:
Aged 18-6, Ava was profoundly hearing impaired due to a high fever in her prelingual years (PTA R=100dB, L=80dB). In September 1983, Ava's language processing and production ages were estimated by the CELF as 6-9 and 7-9 respectively.

Ava's vocational area of training was Health Care which with further education she hoped would lead to employment working with young children in a day care setting. Best friend to Sandra, Ava was also very active in the school as a cheerleader and was recognized by her teachers as a particularly industrious and persistent student. Despite her persistent nature, Ava seemed to have difficulty following class discussions in the hearing impaired program and perhaps as a result her participation seemed to be very limited both in quality and quantity.

Summary of Behavioral Changes:
In September, deficiencies in each of the five areas were observed but particularly with respect to impulsivity and lack of comparative behavior. It was interesting to observe that of all of the I.E. students, Ava was the least influenced by the program. It would appear that the mediation was not getting through and was compounded by her reluctance to participate in the discussions. Her most marked change was observed in planning behavior. Ava began to take more systematic approaches to her work. It appeared that Ava's greatest growth was in an area of least deficiency and amenable to change through the limited mediation she could take in.

An increased responsibility for learning, observed not only in I.E. and English but also in her vocational class, appeared to be reflected in her spontaneous notetaking behavior and spontaneous use of reference materials. Increased linguistic precision in the form of elaboration of detail was also observed. Ava's initial "one right answer" view of the world seemed to be changing as she began to explore multiple alternatives in problem solving.

Appendix D
Description of Regular Program Students

Annette

Background Information:
Aged 18-7, Annette possessed a mild sloping to moderate bilateral sensorineural hearing loss (PTA R=40dB, L=47dB) which had been acquired prelingually. In addition to her hearing loss Annette was also visually impaired. In September 1983, administration of the CELF estimated Annette's language processing and production ages as 12-0 and 9-11 respectively.

It was interesting to note that in two of the five areas investigated no deficiency was observed - demand for linguistic precision and impulsivity restraint. Annette's oral communication was not egocentric or imprecise. She was sensitive to the needs of her listeners and made her message explicit. She was also very reflective in preparing her responses to oral questions; this degree of reflectivity actually inhibited communication because on occasion the delay was so great that the question was forgotten.

Annette's vocational area was Health Care though she did not have any firm ideas about the type of employment she wanted to seek. Instead, her interests lay primarily in employment in office work like her sister. For the most part, Annette was a loner at school. She did not have any close friends, hearing or hearing impaired, with which to share her interest in hockey. Instead, Annette's closest friends were her family which were a tightly knit group. Annette drew heavily on them for support and encouragement.

Though Annette's teachers regarded her as persistent and positive, her behavior also reflected passivity and limited initiative which seemed to interfere with her performance; she did not ask questions when she required help or clarification but instead made do without it. Difficulty was also observed with respect to generalizing between subject areas. Use of logical evidence to support one's opinion or answer was not spontaneous and was even difficult to stimulate.

Summary of Behavioral Changes:
Unlike the I.E. students there did not appear to be any change across the year in the behaviors underlying her performance. She remained reflective and precise but also passive and demanded little of herself with respect to logical evidence and comparative behavior.

Donna

Background Information:
Donna's audiological assessments revealed a bilateral sensorineural hearing loss sloping from moderate to profound (PTA R=65dB, L=73dB) which had been prelingually acquired. Aged 17-9, Donna's language processing and production ages were estimated at 6-11 and 7-2 respectively based on administration of the CELF in September 1983.

Donna's area of vocational training was Health Care and, like Ava, she also was interested in becoming a day care worker. Donna's teachers described her as diligent and hard working but shy.

In September, her classroom behaviors reflected passivity in the sense that she failed to ask questions when help was required. Oral communication with Donna was difficult because of her reduced need to be precise; active questioning on the part of the listener was required to elicit clarifying details. Donna also had difficulty generalizing between subject areas. Comparative behavior did not appear to be a spontaneous and automatic function.

Summary of Behavioral Changes:
Like Annette, across the year changes in these deficiencies underlying her performance were not observed. These deficient functions continued to interfere with her performance.

Ed

Background Information:

Aged 18-6, Ed possessed a severe bilateral sensorineural hearing loss (PTA R=82dB, L=80dB) which had been acquired prelingually. In September 1983 administration of the CELF estimated Ed's language processing and production ages at 7-5 and 7-6 respectively. Ed's deviant syntax suggested a language disorder of a magnitude greater than one would expect to result from his hearing loss.

Ed's vocational area of study was Auto Parts via which he planned to seek an apprenticeship as a partsman. Like Ava and Sandra, Ed was also very active in the school. He played on all of the school athletic teams as well as played and coached hockey in his community. All else took second priority to sports, - even school. While Ed was not an industrious student, he got passing grades and kept lunch hour tutorials and homework time down to a minimum to reserve lots of time for sports.

In September, deficient functions in each of the five areas under study were observed. Ed's responses were often impulsively formulated and required reformulation. Passivity was reflected in his learning habits in the sense that he frequently asked questions eliciting information he could have easily generated for himself. Oral communication was difficult because of his reduced need for precision and elaboration of logical evidence. His listeners frequently had to ask questions to elicit the information he left out of his message.

Summary of Behavioral Changes:

Like the other regular program students, very little change was observed in these behaviors; lack of comparative behavior and demand for logical evidence, impulsivity, imprecision and passivity continued to seriously interfere with his performance. It was interesting to observe, however, that during English class he seemed to become more comfortable with Linda and Janet's frequent demands of him to provide logical evidence for his answers and opinions. While Ed did not provide the evidence spontaneously, he was willing to provide it on their demand.

Appendix E

Analysis of Five Cognitive Education Programs Based on Seven Significant Factors in Choosing a Program for Hearing Impaired Adolescents

	P1	P2	P3	P4	P5
• Motivating to Adolescents			Yes	Yes	Yes
• Accommodating of Cognitive Level					Yes
• Accommodating of Reading Ability				Yes	Yes
• Accommodating of Vocabulary Development					Yes
• Accommodating of Language Skills					Yes
• Accommodating of Conceptual Development					Yes
• Intended Audience	gr5-8	gr5-8	gr10+	gr3+	gr5+

1. P1: Philosophy for Children, (Lipman et al., 1978)
2. P2: Chicago Mastery Learning Reading Program (Jones, 1982)
3. P3: Analytical Reasoning (Whimbey et al., 1980)
4. P4: Cognitive Research Trust (DeBono, 1976)
5. P5: Instrumental Enrichment (Feuerstein et al., 1980)

Appendix F

Sample Reading Closure Task

Every winter _____1._____ out of every two _____2._____ catch a _____3._____. Many _____2._____ think they catch a _____3._____ by being out in wet, chilly _____4._____. This is not true. _____3._____s are caused by a _____5._____ called a virus. _____6._____ can catch a virus by breathing _____5._____-filled air, but _____7._____s now say that most viruses are _____8._____ed from person to person by touching objects covered with _____5._____s. Viruses can live up to _____9._____ hours on skin and hard surfaces. _____10._____ing your hands may be the best way to avoid catching a _____3._____.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Appendix G
Sample Reading Closure Strategy Illustrating Level of Elaboration As Verbalized By An I.E. Student

September

- My strategy is to look at the words what they have there and there are some blanks before and after it.
- Think of a word what is good and it make sense for the sentence.
- If there is the same number you could repeat the same words that you said before and write down.

April

- I read the words that are there to understand what they're talking about.
- And if you don't understand the beginning, just look in the one that's easy. So you start the easiest and go to the hardest.
- If you start from the bottom and there's the same number at the top, like there's a #2, same as the other one at the top #2, so you know the word's supposed to be the same.
- And think of a word which goes there, like I put 'pop'. I just finished off the sentence then go back. If you don't get it, just start in the middle or something.
- Then look it over and over and go over it again and check it over. See if it makes any sense there. And check everything is the same words. You cannot use the same words and different numbers!

June

- I just take a look what it's about because I want to know what it's about. If you don't know what it's talking about, you won't be able to find the answers. So I want to read first and see what it's about, and it talks about bacteria. You know - viruses.
- So I found out now and I don't know what to say at the top, the first sentences or more so I just start from the bottom and find there's the same number. Then use that first because so I could put more word in the same number. You know what I mean? Like if there's #3 down there and there's #3 on the top so you can put the same answer. That's the easiest way but you don't know the answer in the beginning.
- You could think of a word, could be more than three.
- Choose one you think is the right answer for that.
- So then I put another word at the top from the first or second sentences and if I may know what it's about then just go over it again if you get it or not.
- Uh, then I go back the top again and I find out that I want to put "people". There's another same number and same word because I always see it said "catch a ..... catch a ..... catch a ....." so.
- Read it over again to see if it makes any senses or not.
- Then I read over again so "disease" is the right word for it, so I want to see if "disease" make sense in the other #3 space. Then I use the number, the same number again, like #2. There's another #2 so I use again to see what the word goes there.
- Then when you finish if you've got the answer in each blanks, then check it over. Read if there's any make sense if you understand what it means.

Appendix H

Sample Reading Closure Strategy Illustrating Level of Elaboration As Verbalized By A Regular Program Student

September

- To find a clue from a word.
- Then I read the sentence over to find out if the word fit into it.
- Then I read the whole thing over to see if everything was correct.

April

- Look over the sentence to see what words they can find that give them a little hint in the first sentence.
- Then look into another sentence to see if it still gives you another clue.
- Then you read over the sentence to see if the words fit in there or not.

June

- I look at the first word on the blank and the word after the blank.
- Figure out what word would fit in there.
- Read it in my mind, then I put it down on the paper.
- Read it again.
- Then I keep on doing the blanks that was easy and left the hard one out. Then when I had all the easy ones done, I did the hard ones after.
- I read the whole thing in my mind together to see if it's all right or not.